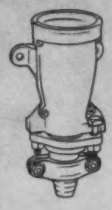
21 JANUARY 1954 NINEPENCE

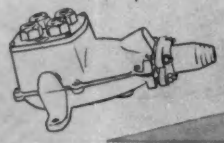
ELECTRICAL TIMES

This *one* box -



VERTICAL CIRCULAR TYPE

RIGHT ANGLE TYPE



UNIVERSAL FLAT TYPE

FLANGE MOUNTING TYPE for inverted use

can be used with twin or 3-core or 4-core cable. You need only stock very few sizes and types of boxes in order to meet the majority of your requirements for 660 volt indoor installations. Henley Catalogue 35 shows which boxes to order.

HENLEY

INDOOR
TERMINAL BOXES
660 volts

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD., 51-53 HATTON GARDEN, LONDON, E.C.1

DIRECT-ON STARTERS

DELIVERY FROM STOCK

IN STANDARD SIZES
1, 2, 3, 5, and 7½ BHP, 380/440 Volts

Brochure S.205 available on Request

ESTABLISHED 1882

THE ELECTRIC CONSTRUCTION COMPANY LTD.

TELEGRAMS: ELECTRIC WOLVERHAMPTON

Head Office and Works:
BUSHBURY ENGINEERING WORKS
WOLVERHAMPTON
ENGLAND

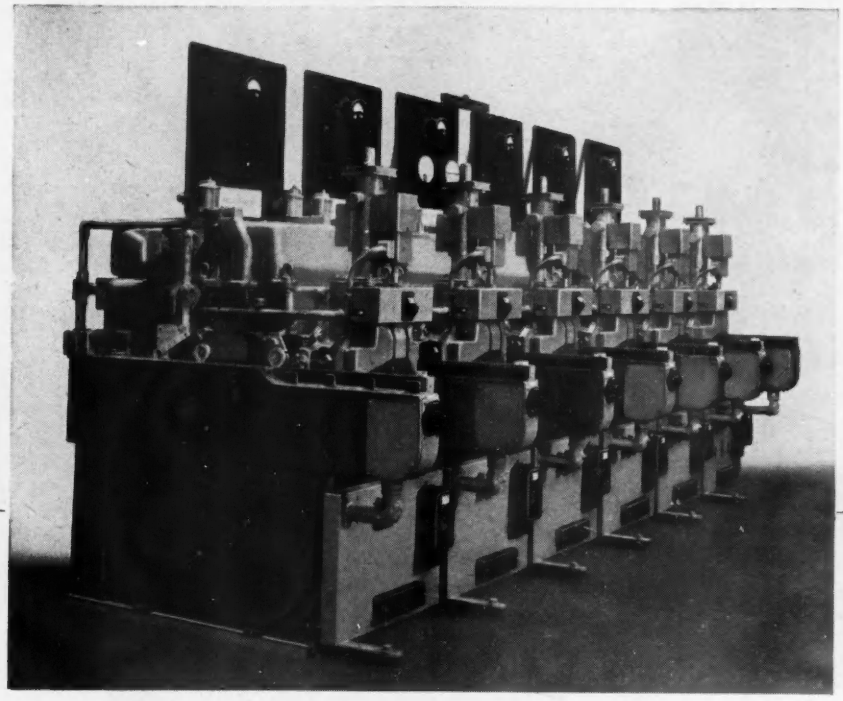
TELEPHONE: WOLVERHAMPTON 21455 (7 LINES)

2660

Manufacturers of Rotating Electrical Machinery, Switch and Control Gear, Rectifiers and Transformers.

District Offices and Showroom for London and the Southern Counties, 57 Buckingham Gate, London, S.W.1. *Telephone*: Victoria 3482/3

Metal-clad switchgear



TYPE OLD1B
(Horizontal draw-out)
Current ratings
up to 1200 amps.
A.S.T.A. certified up to
350 MVA at 11 kV.

Illustrated is a 6.6 kV metal-clad switchboard type OLD1B with hand-charged spring closing mechanism. Other operating mechanisms available are hand, motor-wound spring, or solenoid.

'ENGLISH ELECTRIC'

switchgear

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, W.C.2

Switchgear Department, Stafford

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

SH.10K3

A

TRICITY QUEEN

Deliveries have now commenced

Time-switch controlled cooking . . . Bigger oven heats faster, holds heat longer . . .
Soon the Tricity "Queen" will be the centre of attraction in electrical showrooms throughout the Country.

The immediate demand proves this to be the cooker that housewives have always needed. Write now for the fully illustrated six-colour broadsheet. Send your order early and be among the first to present "The Queen" in your area. Sample orders are being executed in strict rotation.

Tricity

TRICITY COOKERS LTD

109 Kingsway, London, W.C.2. **Telephone: HOLborn 2161**

A PRODUCT OF Thorn ELECTRICAL INDUSTRIES LTD.

You cannot buy better gear

CROWN

BILL CROWN SWITCHFUSES AND SWITCH SPLITTERS

DESIGNED FOR SP/N CIRCUITS.
SLOW BREAK A.C. SWITCH.
OPERATED FROM THE FRONT.
ALL-INSULATED AND METAL CLAD.
FOR 15 & 30 AMPERES 250 VOLTS.
SPECIALLY DESIGNED FOR MODERN DOMESTIC INSTALLATIONS

FOR NEW PRICES APPLY FOR CROWN LEAFLET

BILL SWITCHGEAR LTD.
ASTON LANE · PERRY BARR
BIRMINGHAM·20

LONDON, S.W.1. A. W. ZELLEY, 61 PETER ST.
MIDLANDS. G.H. GARBETT. HEAD OFFICE.
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GLASGOW. J. D. HARRIS. ST VINCENT LANE

What goes on in Quality Street?

"NO ONE EVER SAYS 'NO' TO MACKINTOSH'S"

. . . as the advertisements say, and with good reason. You don't stay at the head of the parade in Quality Street year after year without making a tip-top product and without putting behind it all you've got in shrewd buying, manufacturing know-how and enlightened merchandising.

It is no coincidence that Mackintosh's, like so many other successful firms, make good use of Delaron Laminated Plastic. They use this versatile material for tough, smooth, easy-to-clean work-bench tops. Other people use it for a truly bewildering variety of jobs. Its exceptional combination of qualities may provide you with just what you want.

WHAT IS YOUR NEED? If you are looking for exceptional strength plus lightness (Delaron is half the weight of aluminium), if you want a material you can machine more easily than steel, if you want good chemical resisting qualities, or dependable insulation—at economical cost—then you'll find that Delaron gives you a better job for less.

Is your product here—cars, toys, office equipment, chemical plant, textiles, aeroplanes, radios, refrigerators, washing machines, stockings, food? Do you use gears, benches, machine guards, filing cabinets, templates, acid tanks? Then you'll be interested in Delaron, and it will pay you to find out more about it.

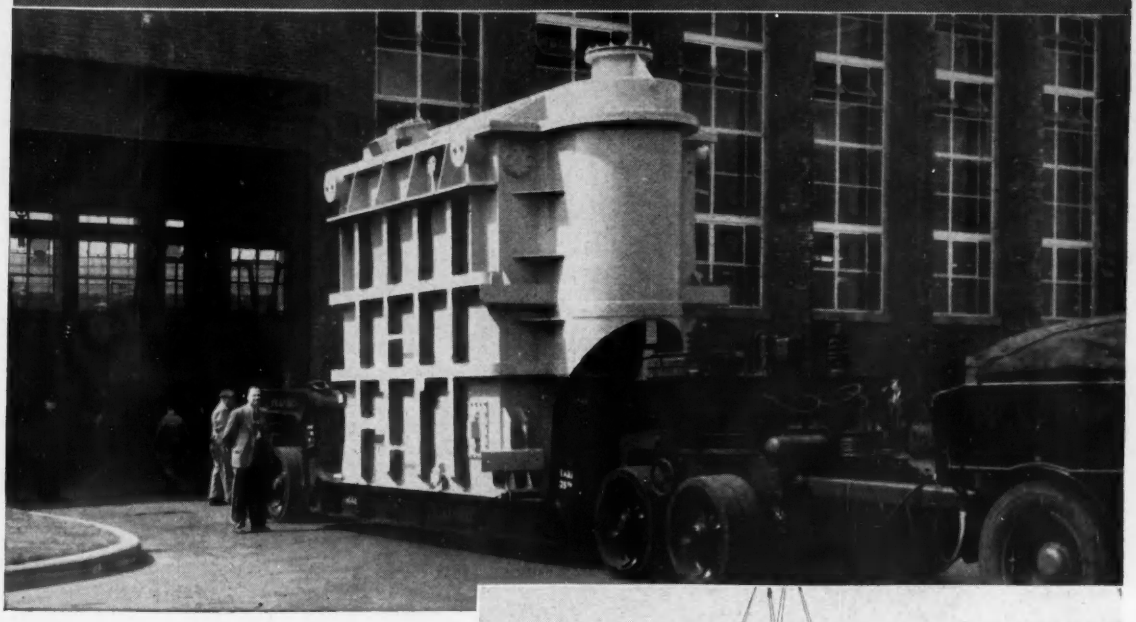
YOU CAN DO A BETTER JOB FOR LESS WITH

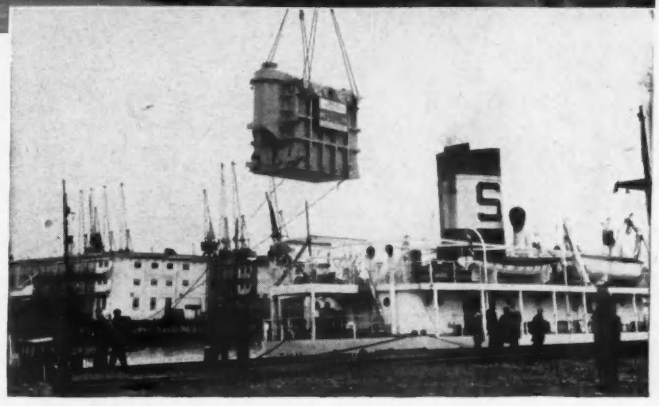
Delaron REGD
LAMINATED PLASTIC
MADE BY
DE LA RUE

WRITE FOR THE DELARON LEAFLET TO THOMAS DE LA RUE & CO. LTD. (PLASTICS DIVISION), 84-86 REGENT STREET, LONDON, W.1.
TELEPHONE: REGENT 2901.

301,400 volts

HIGHEST EVER





The first of four 71,000 kVA 301,400 volt—THE HIGHEST EVER MADE IN BRITAIN—singlephase Ferranti Generator Transformers for the Alcan Project, Canada has been shipped to Kemano, British Columbia. Three 37,000 kVA, 275,000 volt step down Transformers are also being supplied for use at Kitimat.

FERRANTI

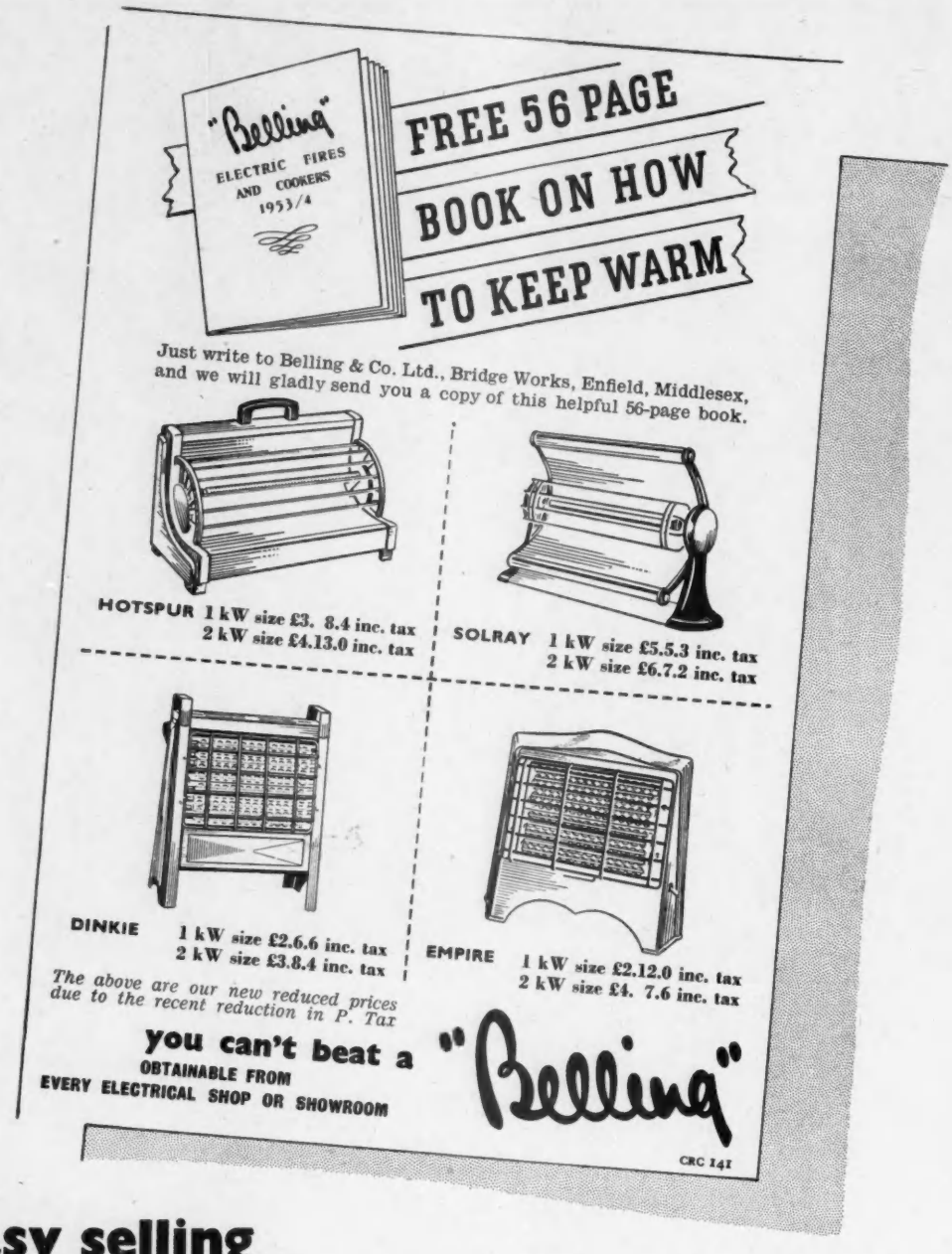
EARNING $$$$$$ FOR BRITAIN

FERRANTI LTD · HOLLINWOOD · LANCS.

London Office: KERN HOUSE, 36 KINGSWAY W.C.2.

FERRANTI

FT134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ELECTRIC FIRES AND COOKERS 1953/4
FREE 56 PAGE BOOK ON HOW TO KEEP WARM
Just write to Belling & Co. Ltd., Bridge Works, Enfield, Middlesex, and we will gladly send you a copy of this helpful 56-page book.
HOTSPUR 1 kW size £3. 8.4 inc. tax
2 kW size £4.13.0 inc. tax
SOLRAY 1 kW size £5.5.3 inc. tax
2 kW size £6.7.2 inc. tax
DINKIE 1 kW size £2.6.6 inc. tax
2 kW size £3.8.4 inc. tax
EMPIRE 1 kW size £2.12.0 inc. tax
2 kW size £4. 7.6 inc. tax
The above are our new reduced prices due to the recent reduction in P. Tax
you can't beat a "Belling"
OBTAINABLE FROM EVERY ELECTRICAL SHOP OR SHOWROOM
CRC 141

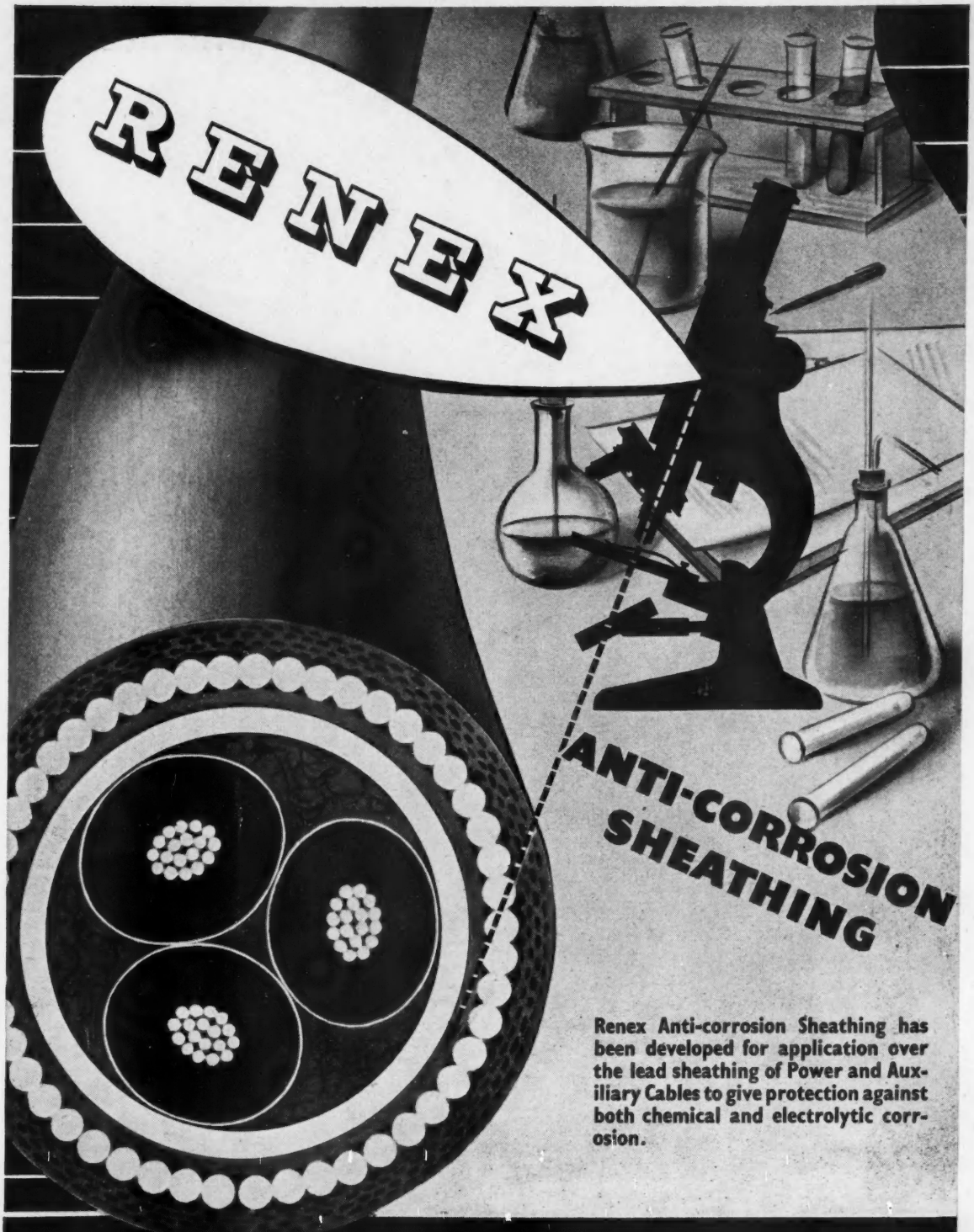
For easy selling

This is the Belling advertisement which is now appearing in the national, provincial and local press, and magazines all over the country. Make sure you have some of these fires ready to meet the demand.

You can't beat a "Belling"

Belling & Company Ltd., Bridge Works, Enfield, Middx. Howard 1212

CRC407



Renex Anti-corrosion Sheathing has been developed for application over the lead sheathing of Power and Auxiliary Cables to give protection against both chemical and electrolytic corrosion.

SCOTTISH CABLES LIMITED

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LONDON OFFICE • BUSH HOUSE • ALDWYCH, W.C.2

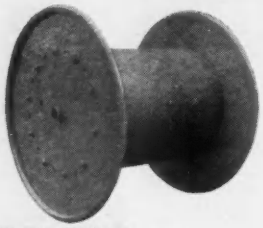
Associated Company: SCOTTISH CABLES (SOUTH AFRICA) LTD. PIETERMARITZBURG, NATAL

WOOD

AND STEEL

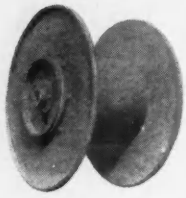
REELS

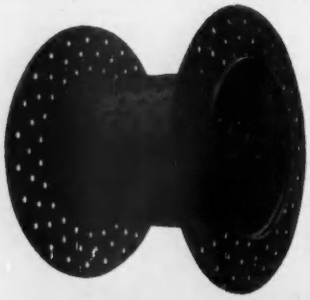
OF EVERY



KIND

FOR THE ELECTRIC WIRE AND CABLE TRADE





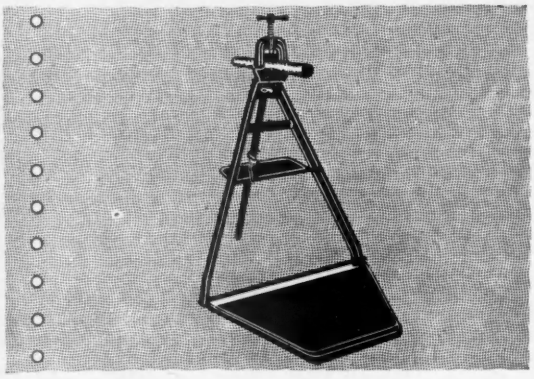
Makers of all kinds of wood and steel reels for the electric wire and cable trades.

Our speciality:–Steel flanges with very strong beaded edges in a wide range of diameters, and friction rings made wholly from mild steel.

REELS
LIMITED

BYRON STREET PRESTON : 'PHONE: 3922

Pipe Vices and Stands



- Pipe Vice (PV.1) Capacity ⅛" to 2"
- Specially hardened steel jaws.
- Can be fitted to Bench or Stand.
- Pipe Vice Stand (PVS.3)
- Portable but extremely rigid.
- Fitted with tray for tools.
- Obtainable from your local
- machine tool distributor.

Tubela

Tubela Engineering Co. Ltd.
Furze Street, Bow, London, E.3
Telephone: East 4771 (3 lines)

"... and we can handle the production, too"

"That's the advantage of the "Electro Dynamic" service. Our Design Department can adapt or completely redesign electrical units for your particular requirements. We can also handle the production of a medium run — not mass production work, of course, but anything reasonable. You'll find our prices most economical, and we can promise good delivery!"

The "Electro Dynamic" range includes:

Radio Rotary Converters
Radio Rotary Transformers
Motor Generator and Control Gear for test equipment
Power Plant for Electronic equipment

ELECTRO DYNAMIC CONSTRUCTION COMPANY LTD.

ST. MARY CRAY, KENT *Phone: Orpington 2560/3*

Control Gear Works: **BRIDGWATER, SOMERSET** *Phone: Bridgwater 2882*

LATEST ADDITION

The latest addition to our range
is a direct-to-line starter with interlocked isolator, rated up to 7½ H.P. and illustrated above.

Despatch of standard starters

—EX STOCK

The starter can be fitted with Ammeter, Floor-Stand and Tryout-device within a few days.

Full particulars from

CONTACTOR SWITCHGEAR LTD

BLAKENHALL WOLVERHAMPTON ENGLAND

Telephone: Wolverhampton 25111 (5 lines) *Telegrams:* TACTORGEAR Wolverhampton

High grade materials for heavy duty elements

The Brightray series of nickel-chromium alloys provides a range of electrical resistance materials for use in various types of heating elements. Brightray S is the grade principally used for furnace heating elements and is satisfactory in both oxidising and reducing atmospheres at temperatures up to 1,150°C. Brightray F is a new composition for electric-furnace elements operating at temperatures not exceeding 1,000°C. It is recommended in preference to Brightray S only where the furnace atmosphere is carburizing or is of such a character as to lead to 'green rot' in the elements.

Other grades available

BRIGHTRAY C, for long-life elements, principally in appliances submitted to intermittent heating and cooling.

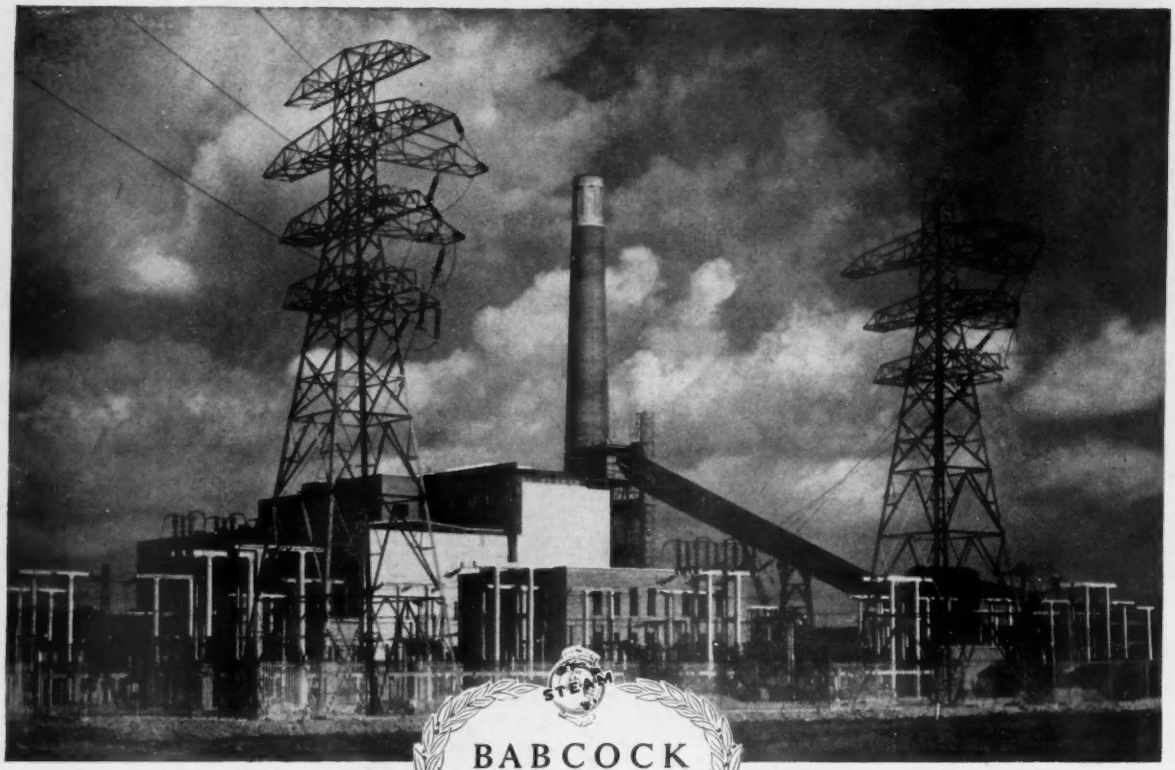
BRIGHTRAY B, a cheaper material for elements working up to 950°C.

HENRY WIGGIN AND COMPANY LIMITED

WIGGIN STREET · BIRMINGHAM · 16

'Brightray' is a Registered Trade Mark

16/BR/40



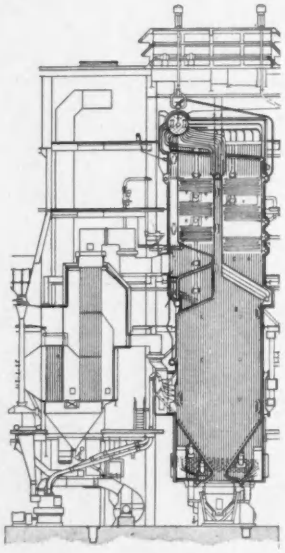
BABCOCK

CARRINGTON POWER STATION

B.E.A. NORTH WESTERN DIVISION

The Babcock boilers at the new 240 MW. Carrington power station are Radiant units, each with an evaporation of 360,000 lb./hr. at 940 lb./sq. in. and 920° F., and fired with pulverized coal by means of eight horizontal intertube burners.

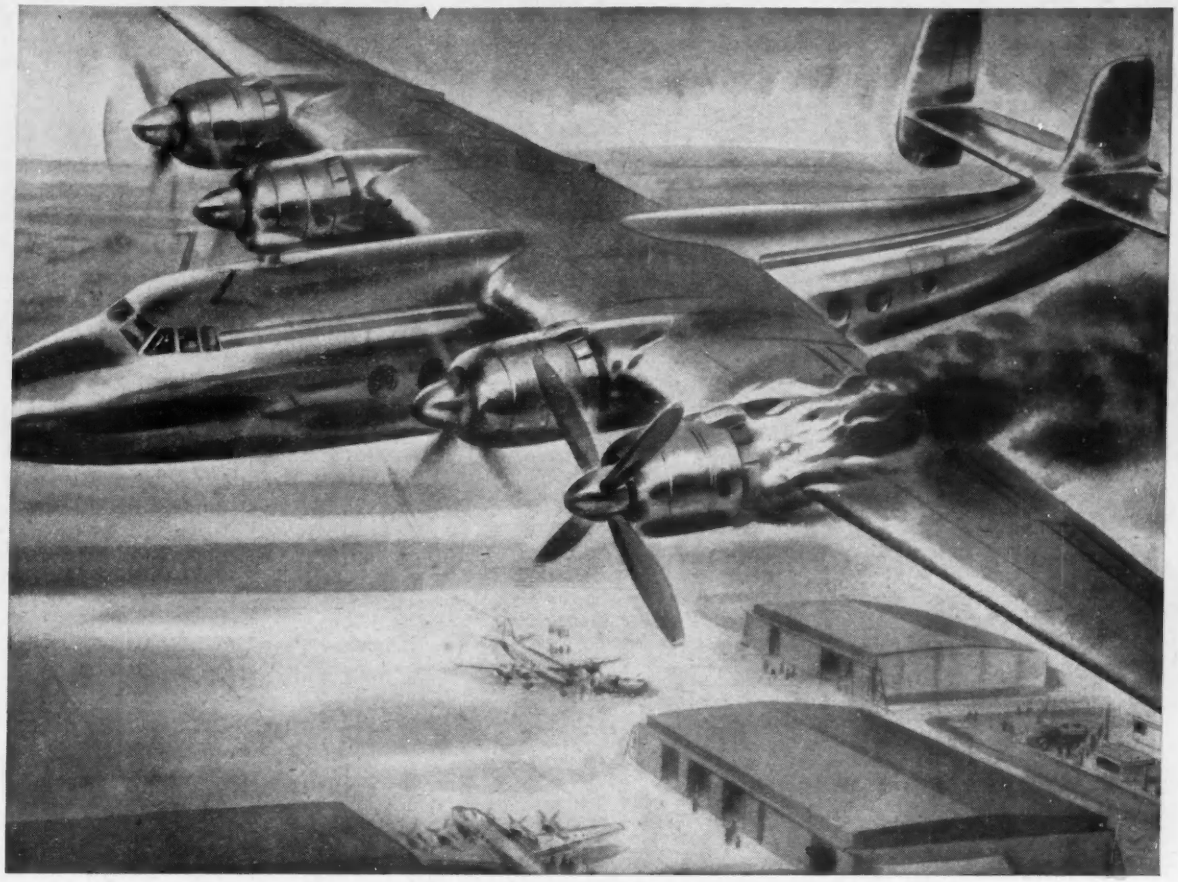
The contract includes all the coal pulverizing plant, comprising 28 Babcock type E mills to feed seven boilers.



Ash, collected in the 'A' type water-filled hoppers is discharged to sump by the "*Hydrojet*" system, being pumped to settling ponds by "*Hydroseal*" ash pumps. Dust is extracted from the precipitator and air-heater hoppers by the "*Hydrovac*" system. All this is Babcock equipment, widely used in both power station and industrial installations.

Babcock & Wilcox, the world's largest manufacturers of steam-raising plant, offer to steam users large or small a comprehensive, world-wide service embracing everything for steam generation from fuel handling to ash and dust disposal.

BABCOCK & WILCOX LTD. BABCOCK HOUSE. FARRINGDON STREET. LONDON. E.C.4.



Once this would have meant almost certain disaster . . .

Today it probably means no more than an extra job for the ground staff — for modern multi-engined aircraft will fly with one or more engines shut-down . . . provided the controls to the remaining engines are intact. This is one reason why most aircraft use 'Fibreglass' insulated Pren* cables which stand up to direct exposure to flame. Other reasons — which apply to all 'Fibreglass' electrical insulation — are less weight, less space, greater heat resistance, higher safe working-temperatures, freedom from alkali with consequent resistance to moisture. All of which mean longer life and greater reliability.

**'Pren' cables incorporate one or more layers of braided glass fibre and are finished with a fire-retarding lacquer.*

wrap it in* FIBREGLASS *for safety

TRADE MARK

DURABLE · FIRE-SAFE · ECONOMICAL · AND AVAILABLE NOW

FIBREGLASS LTD., RAVENHEAD, ST. HELENS, LANCS. (ST. HELENS 4224)

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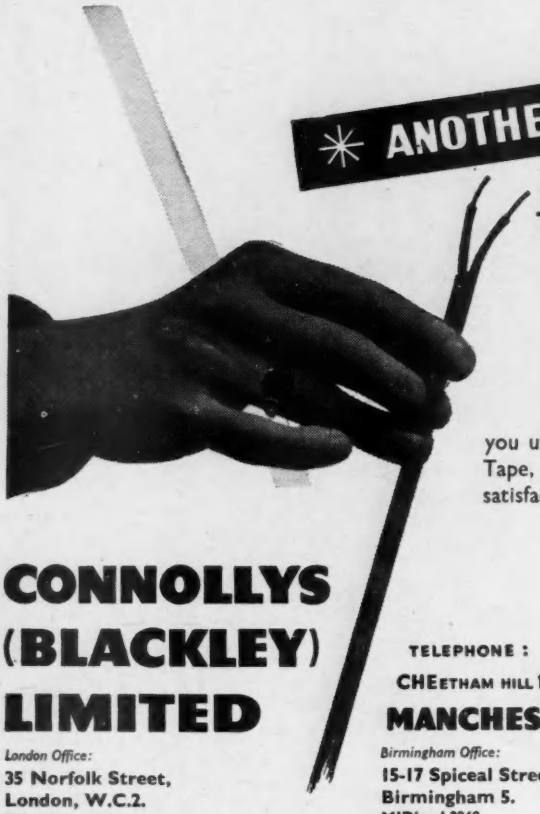

✳ ANOTHER JOB FOR LIMPET TAPE

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How often are those words heard in factory, workshop, garage and home—and they imply complete reliability both in the matter of electrical insulation and also for a wide variety of other applications.

The quality of the adhesive compound is unsurpassed and whether you use or sell Limpet Tape, your complete satisfaction is assured.

We invite you to write for descriptive literature and samples of Limpet Tape.

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Angelus **ELECTRIC FIRES OF DISTINCTION**

- *MODERN*
- *EFFICIENT*
- *ARTISTIC*

The New Safety Fire Guard complies with the latest British Standard requirements.

SPERRYN & COMPANY LIMITED

(Formerly Ingram, Kemp and Joyner)

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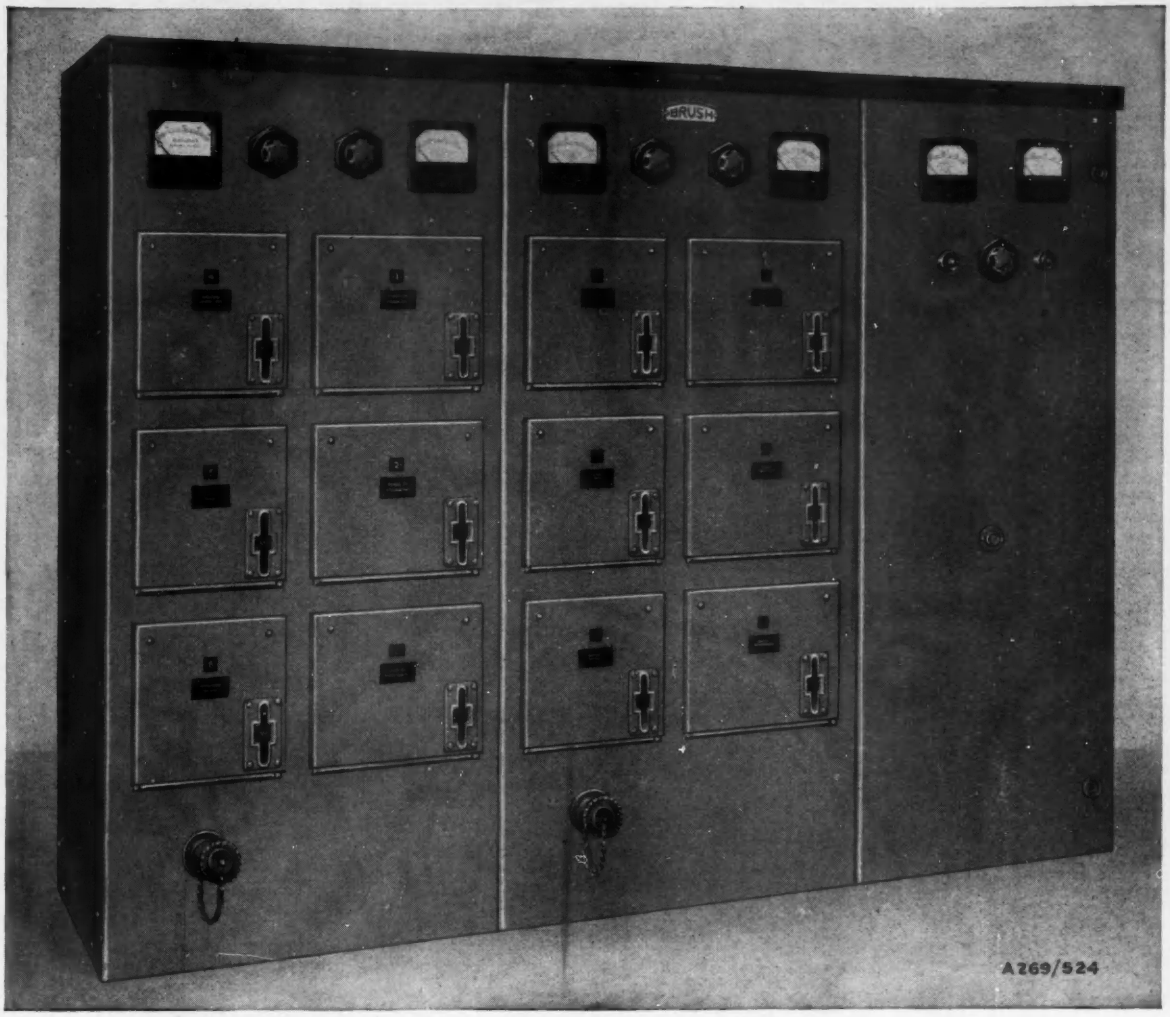


Space-saving switchboards

Brush A.F. type distribution gear is specially designed to save both valuable floor space and the expense of installing circuit breakers on each individual circuit. Design is neat and compact ; high rupturing capacity fuse switches are employed on individual outlets, with automatic circuit breakers on the primary circuits only. All parts are easily accessible for maintenance and fuse removal. Brush A.F. type distribution gear is available for A.C. circuits up to 600 volts. Publication No. 41050 gives the full specification.

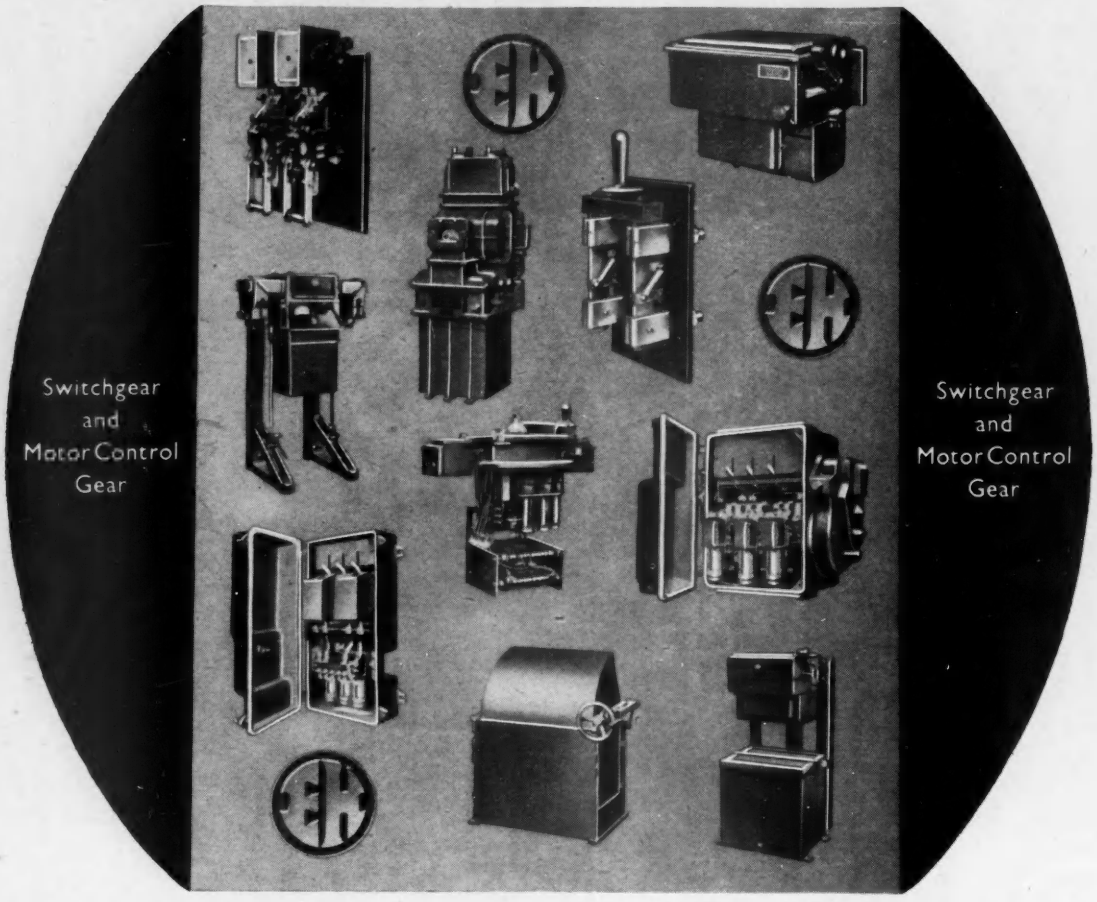
Switchgear by **BRUSH**

THE BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH, ENGLAND

Birmingham · Bristol · Cardiff · Glasgow · Leeds · London · Manchester · Newcastle · Sheffield B26

Standardise on "Erskine Heap"

SPECIALISTS IN THE MANUFACTURE OF SWITCHGEAR SINCE 1905



It's the Switchgear engineers like to "Live" with

L.T. SWITCHGEAR *50/5000 AMPERES*
E.H.T. SWITCHGEAR *up to 11 kV 250 MVA rupturing capacity*
MOTOR CONTROL GEAR *¼/5000 H.P.*

May we have your enquiries?

ERSKINE, HEAP & Co LTD

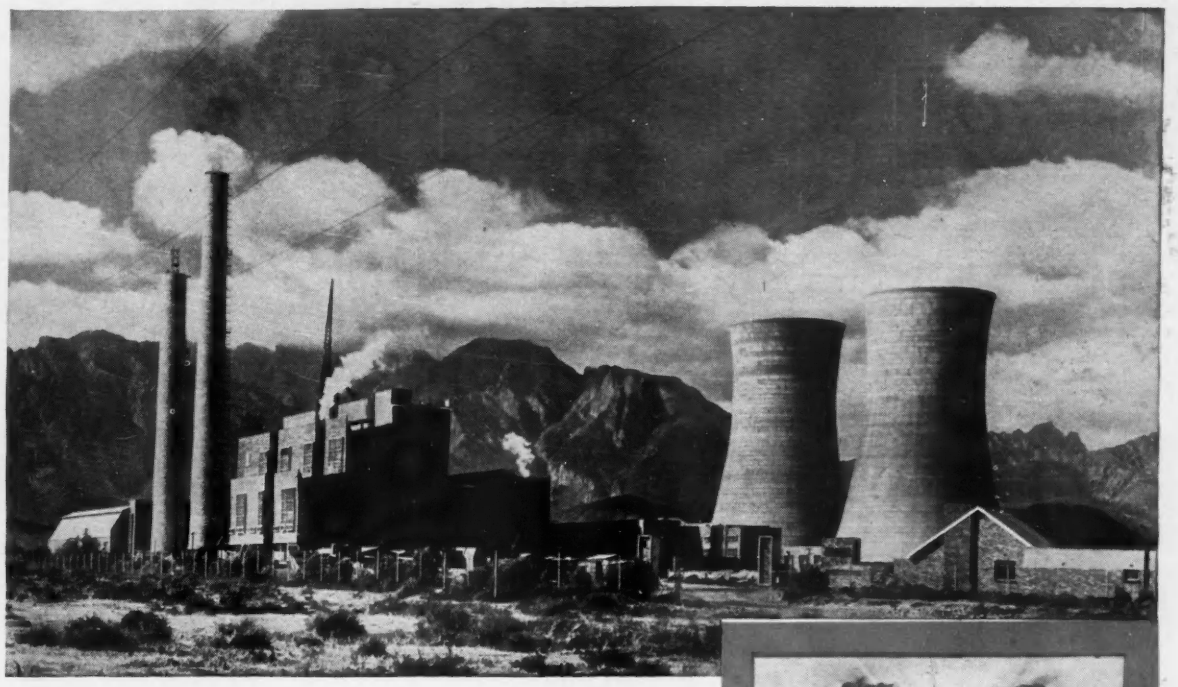
SWITCHGEAR SPECIALISTS

Head Office and Works
BROUGHTON, MANCHESTER (7)

London Office
GRAND BUILDINGS, TRAFALGAR SQ., W.C.2

BRANCH OFFICES AND AGENCIES IN ALL PARTS OF THE WORLD

POWER for South Africa



One of South Africa's most modern power stations is nearing completion on the banks of the River Hex. It is being built at a cost of £3,600,000 for the South African Electricity Supply Commission. The station will feed a rapidly expanding industrial area, an extensive rural network, and will also provide for the Cape Town-Touws River Railway, when electrification is completed.

Many miles of all types of BICC cable have been supplied and installed in the new station by British Insulated Cables (S.A.) Ltd. This company is a member of the BICC group—who have more than 60 years experience in the supply of cables for power stations in all parts of the world.

A view of the station against the background of the Brandwatch Mountains.
(Below) One of the cable bridges.

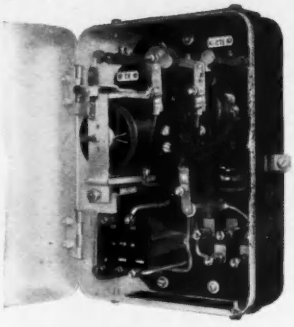
BICC CABLES for POWER STATIONS

BRITISH INSULATED CALLENDER'S CABLES LIMITED BI Callender's 21, BLOOMSBURY STREET, LONDON, W.C.1.

B

IGRANIC **DIPSTICK**
WATER LEVEL CONTROL

PUMPS OR OTHER MACHINERY OPERATED AUTOMATICALLY BY CHANGE IN WATER LEVELS REQUIRE A ROBUST, EFFICIENT AND TROUBLE-FREE CONTROL SYSTEM



CATALOGUE 9555I. SENSITIVE TYPE DIPSTICK WATER LEVEL CONTROL RELAY

THE IGRANIC DIPSTICK CONTROL SYSTEM MEETS ALL THESE REQUIREMENTS AND IS PARTICULARLY RECOMMENDED FOR ELIMINATING ERRATIC OPERATION DUE TO TURBULENCE

FULL PARTICULARS ON APPLICATION TO PUBLICITY DEPT., BEDFORD

ELECTRODE HOLDERS COMPRISING CAST IRON BODY and SUBSTANTIAL MOULDED INSULATOR

ELECTRIC IGRANIC CO. LTD.

IGRANIC ELECTRIC CO. LTD. **HEAD OFFICE AND WORKS: BEDFORD**

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BRANCH OFFICES : LONDON · BIRMINGHAM · BRISTOL · CARDIFF · EAST ANGLIA
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This specialist service in NICKEL AND NICKEL ALLOYS

FURNACE ELEMENTS	Nickel alloys for long life at high temperatures; for certain special atmospheric conditions; for furnace constructional work.
DOMESTIC APPLIANCES	"Nichrome" V for long life at temperatures up to 1,150°C; "Nichrome" for temperatures up to 950°C; other alloys for less exacting conditions.
THERMO-COUPLES	"T1/T2" alloys (nickel-chromium and nickel-aluminium) for temperatures up to 1,100°C, are identical with the best-known wires formerly imported. Also Special "Advance" (nickel-copper) for use with copper or iron.
RADIO and TV FIELD	Cathode nickel, pure nickel and nickel-manganese, for sleeves, anodes, grids filaments, supports, glass metal seals, etc.
LAMP INDUSTRY	Nickel-manganese for supports, grids, and lead wires; special alloys for a variety of efficient joints between metal and glass.
SPARK PLUGS	Alloys of the correct physical properties and temper to meet manufacturing requirements in centre and side electrodes; and such as special strip for stamping out multi-point discs for aircraft plugs.
FINE WIRES	Very fine wires from 0.002 in. downwards in various alloys, such as 80/20 Nickel Chrome, Pure Nickel, etc., for specialized applications.

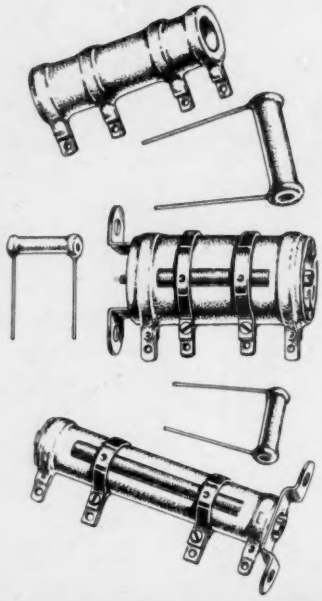
BRITISH DRIVER-HARRIS CO. LTD.

MANCHESTER 15

The greatest name in electrical resistance

"NICHROME"
REGISTERED TRADE MARK

WIRE WOUND RESISTORS



C.R.M. resistors are wound on high grade low loss ceramic tubes. They can be coated with — Silicone Resins — Vitreous enamel or Cement with terminations to suit customers requirements.
C.R.M. resistors have a low temperature Co-efficient of resistance, are of robust construction and can be used under conditions where reliability and stability are important factors.
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COXOHM AUTOMATIC VOLTAGE *REGULATOR*

- Suitable for large A.C. or D.C. machines.
- Possesses extreme sensitivity.
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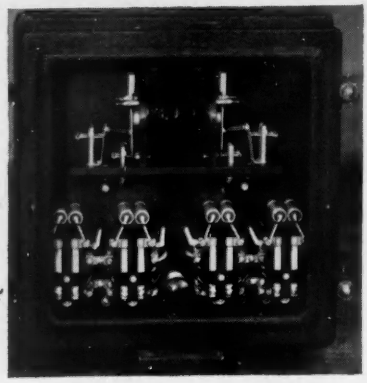
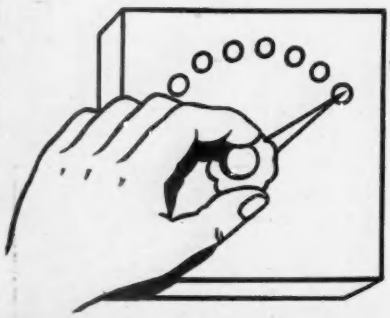
- Full balancing gives stability under mobile conditions.
- Simple to install and to put into operation.
- Maintenance negligible.



As specialists in the field we shall be pleased to advise on the question of automatic voltage regulation if we may receive particulars of your specific requirements for any loading.



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NORTH EASTERN ELECTRIC WORKS
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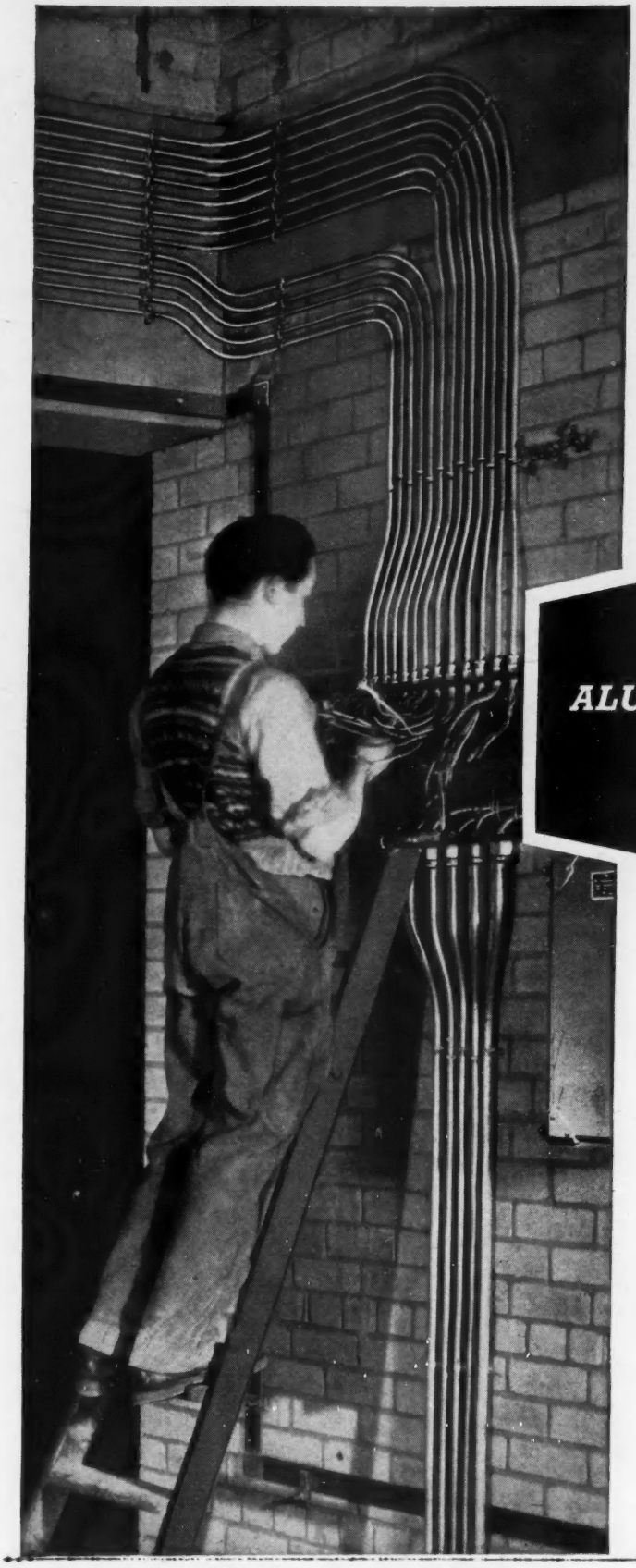

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and yet... SO RESISTANT TO DAMAGE

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. . . the cable with a conduit sheath

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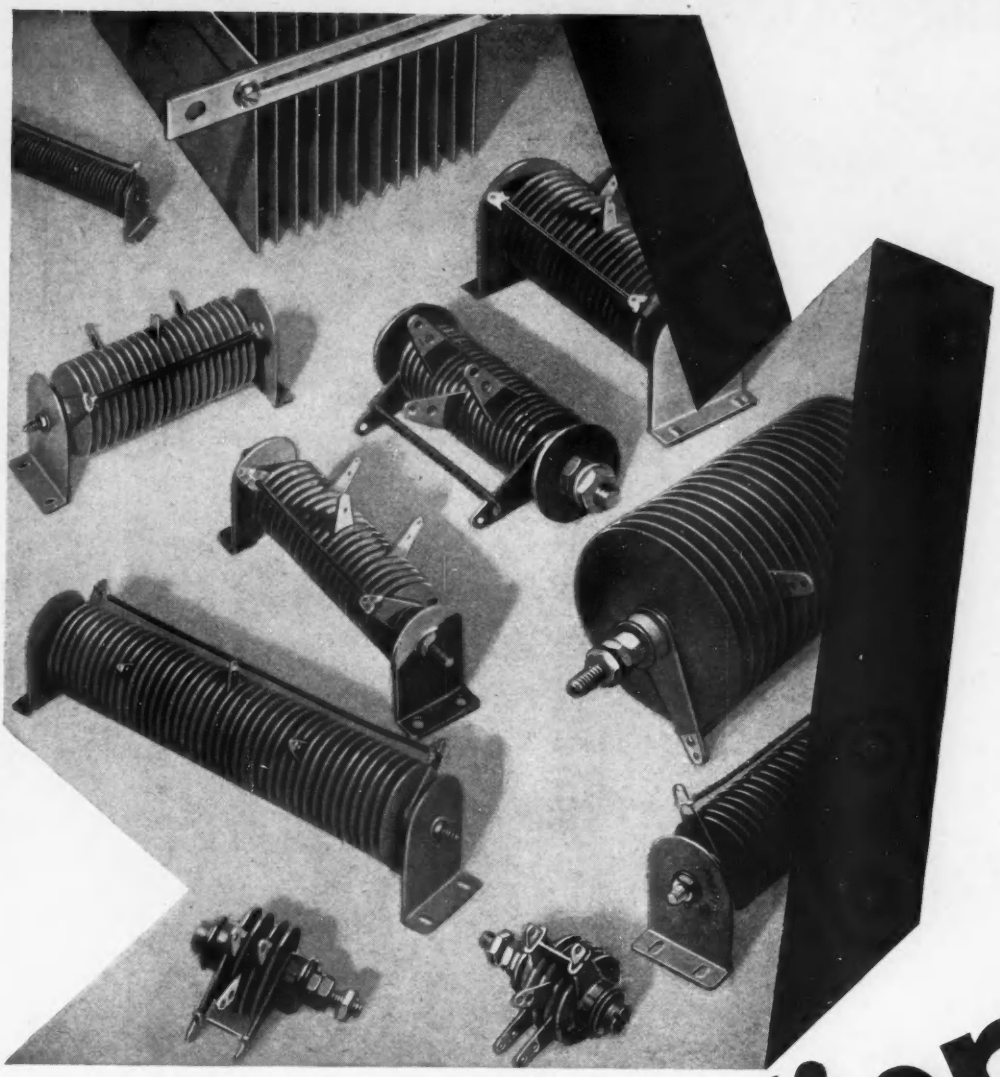

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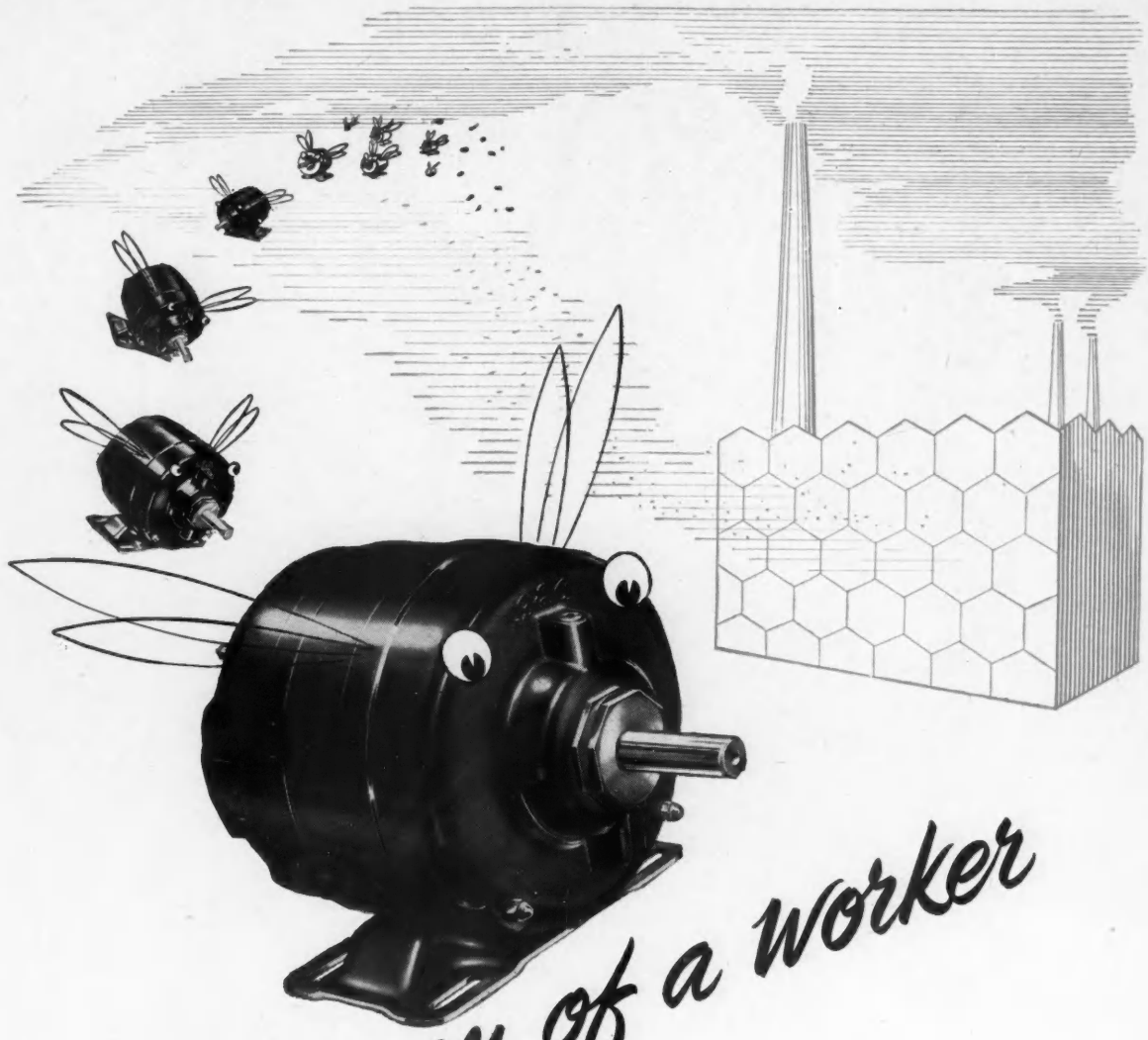

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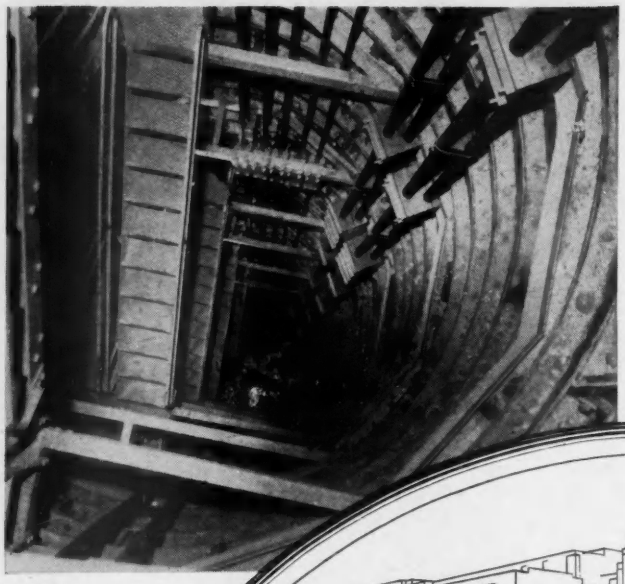
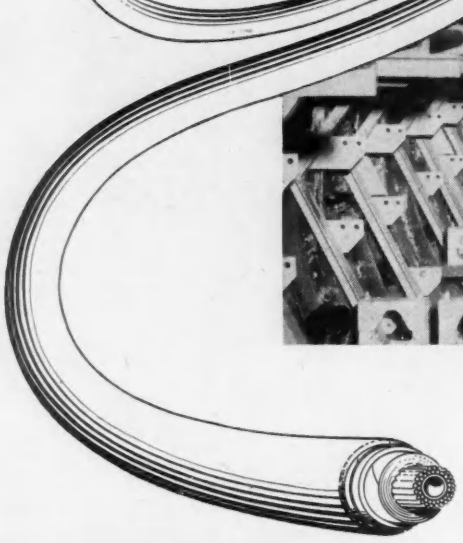


Nine miles

of 132 kV. OIL-FILLED CABLE for BRIGHTON "B"

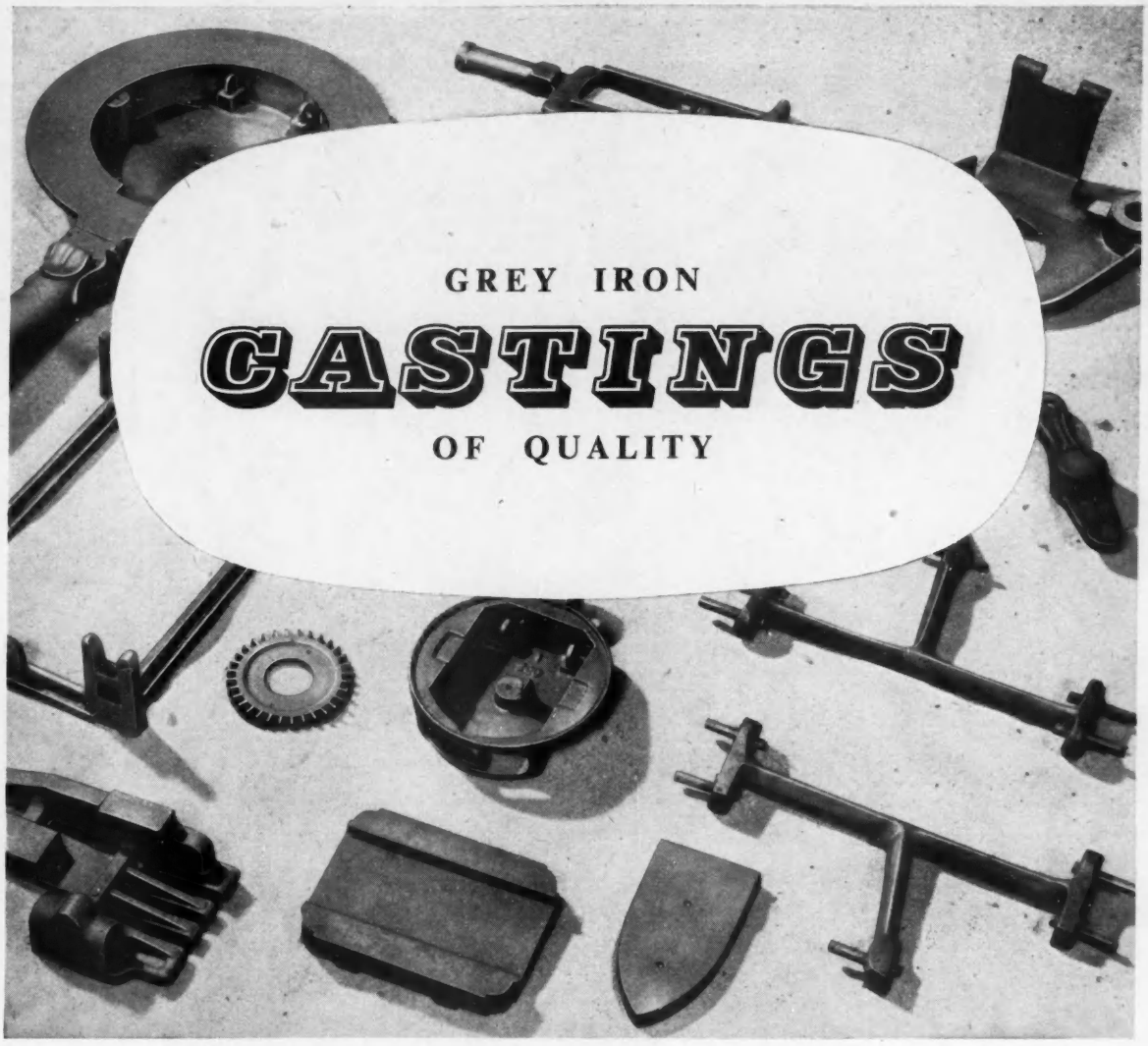


Pirelli-General Cable Works Ltd. have supplied over 9 miles of single core 132 kV. oil-filled cable to the British Electricity Authority for the new Brighton "B" Power Station. Shown here is some of the cable that has been laid in a specially constructed tunnel under Shoreham Harbour, which connects two of the generator transformers to the Southern Cross, Switching Station.

PIRELLI-GENERAL *cables*

PIRELLI-GENERAL CABLE WORKS LIMITED — Southampton

Associated Company of the General Electric Co. Ltd.



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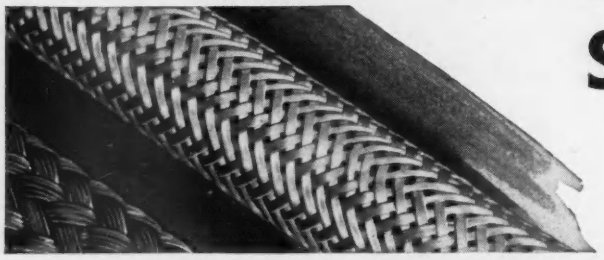

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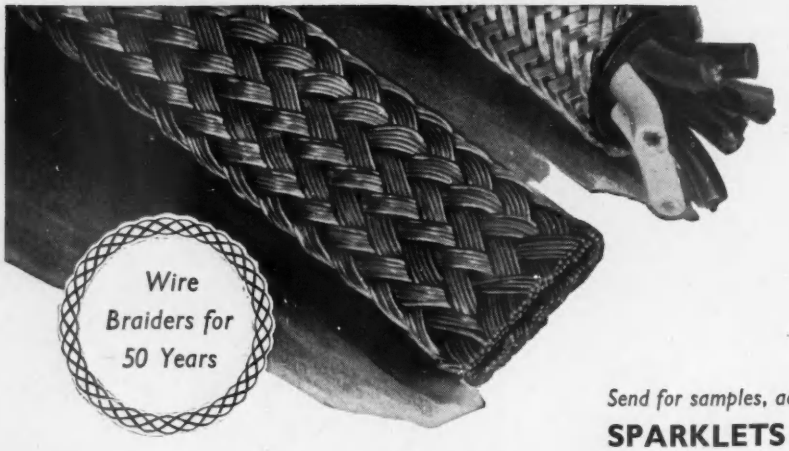

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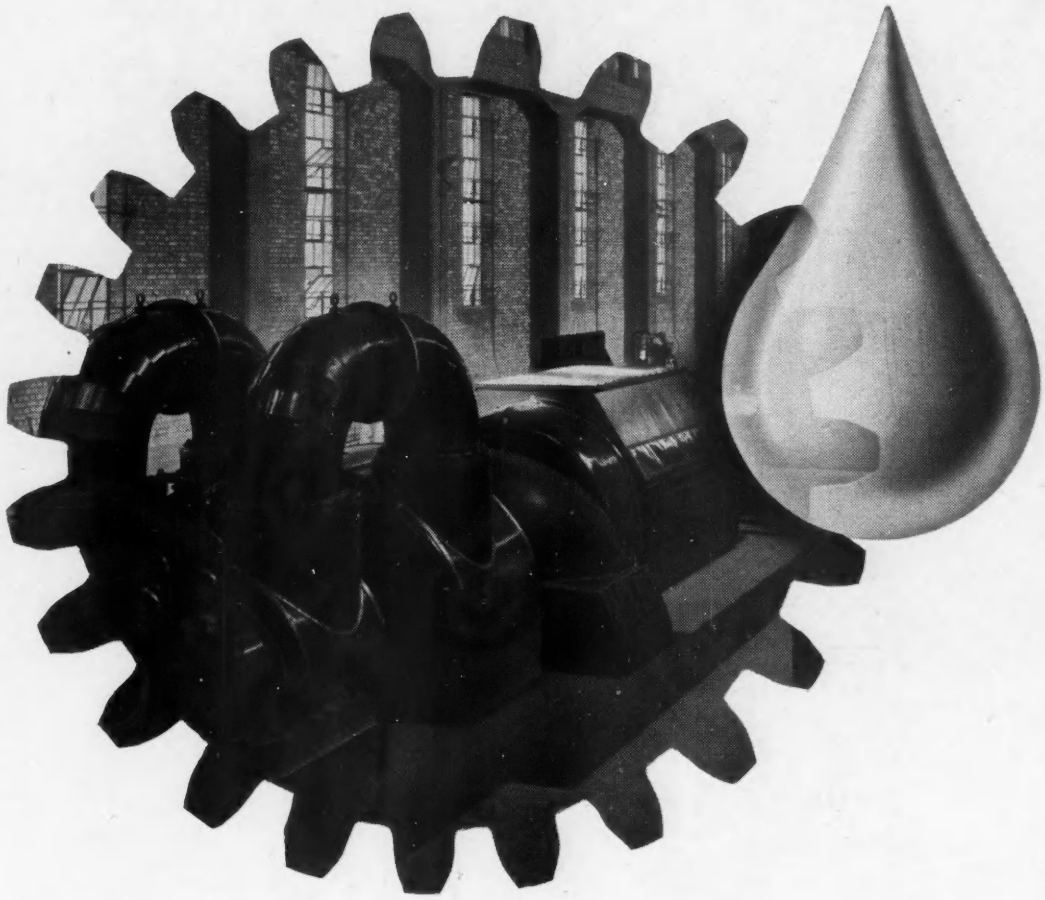

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60	T1S60	616	903	2022
100	TC100	615	932	2021
200	TF200	251	933	2033
300	TKF300	252	934	2032
400	TM400	629	935	2031
500	TT500	354	936	2025
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Metrovick lighting equipment is used throughout for the interior lighting installation at Huncoats, Barking 'C' and Carmarthen Bay power stations of the B.E.A.

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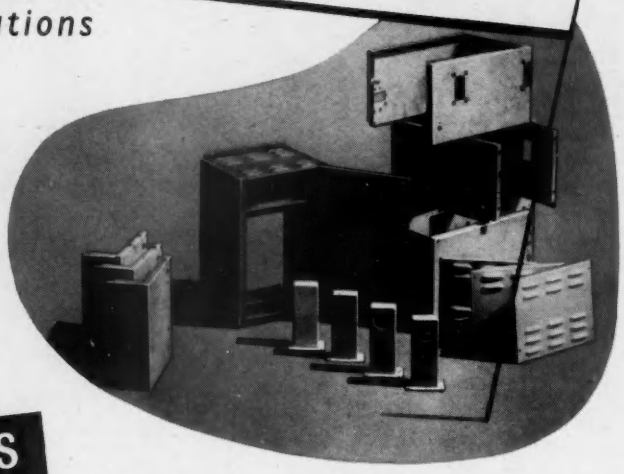

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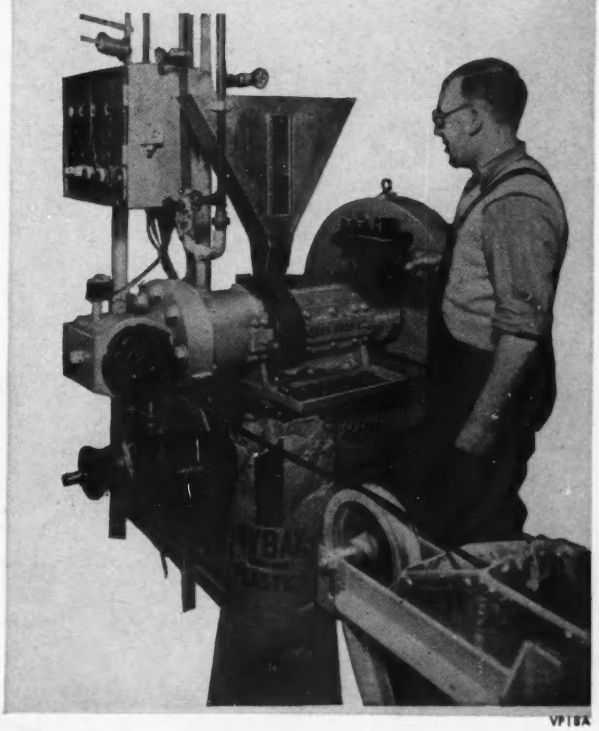

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A CROMPTON LIGHTING FITTING is more than a holder for a lamp. Each is a piece of equipment designed for particular lighting needs and particular working conditions. Design of reflector, method of mounting and materials used all match the duty. It brings you the right lighting at lowest possible operating cost.

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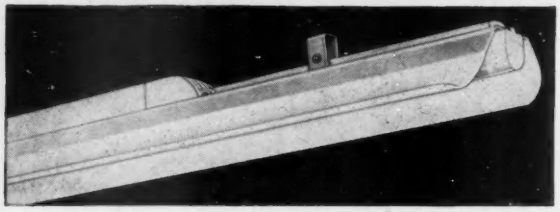
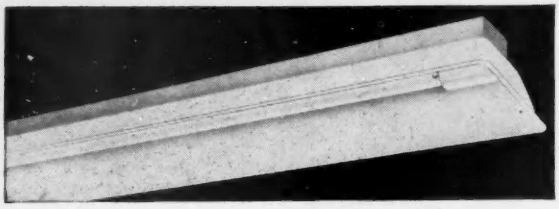
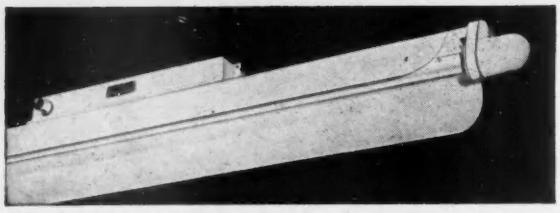


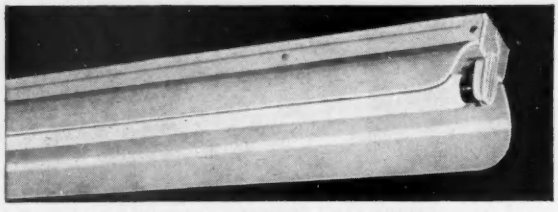
OPEN END METAL DISPERSIVE REFLECTOR Finished all over in 'Permawhite'. For one 80 watt 5 ft. lamp. With closed top (AK 1111) or with slotted top for some upward light (AM 1111). Price complete with switch start control gear **£8.10.0** (AK 1111)



'PERSPEX' DISPERSIVE REFLECTOR DIFFUSER High resistance to corrosion. All-round light. Easy cleaning. In two models. For one or two 80 watt 5 ft. lamps. Prices complete with switch start control gear from **£12.5.0** (AT 1413)



VAPOUR AND DUST-PROOF FITTING All vulnerable parts sealed from atmosphere. Choice of reflectors in vitreous enamel, 'Perspex' or white hard P.V.C. For one 80 watt 5 ft. lamp. Prices complete with switch start control gear from **£16.8.8** (AV 1113)



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Weight 6½lbs. (including leads)

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2·5V.	50μA.	2·5V.	100mA.	*First indication* 0·5Ω.
10V.	250μA.	10V.	1A.	*Maximum indication* 20MΩ.
25V.	1mA.	25V.	2·5A.	0—2,000Ω { using internal batteries.
100V.	10mA.	100V.	10A.	0—200,000Ω { using internal batteries.
250V.	100mA.	250V.	—	0—20MΩ { using internal batteries.
1,000V.	1A.	1,000V.	—	0—200MΩ { using external batteries.
2,500V.	10A.	2,500V.	—	

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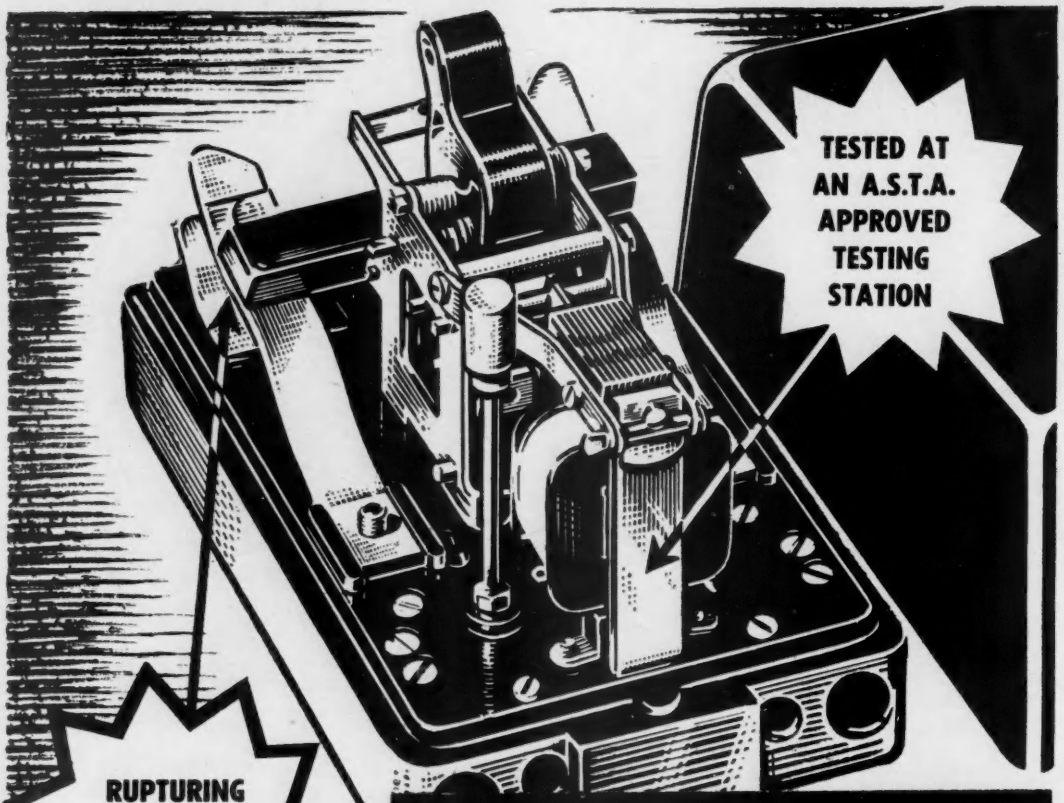

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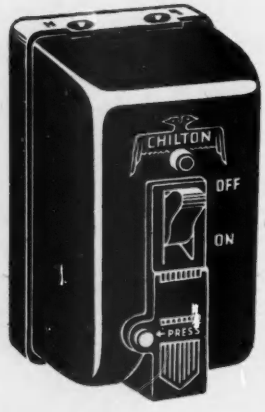

Type ELT/A—(Without overload protection).
A robust Double Pole unit built in full accordance with BS:842:1939. Tripping mechanism designed to give reliable operation even after long periods of inaction. **0 to 60 amps 39/9**

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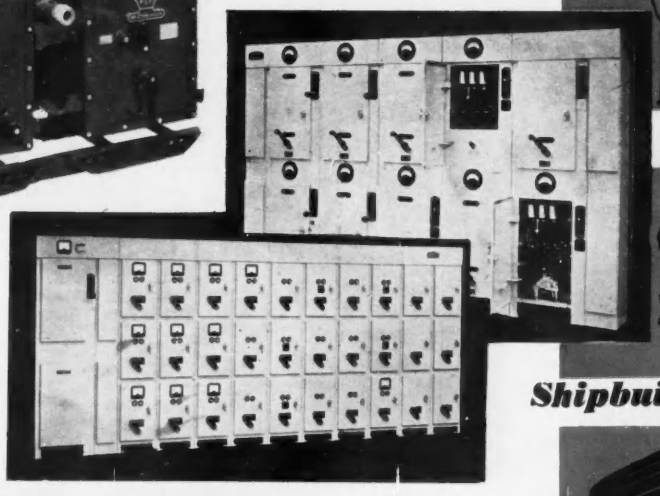
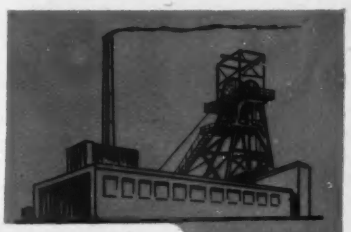
a name increasingly specified for switchgear and electric motor control gear...

Where the explosion hazard is present, the "Belmos" flameproof range meets all the requirements of rugged construction and unfailing reliability, whilst the unique unit construction permits assembly of switchboards on site and makes alterations, additions and servicing extremely simple. For industrial applications, the "Belmos" industrial range has set a new standard of functional excellence and finish in line with contemporary trends. The ingenious unit type cubicle construction with concealed hinges provides a totally enclosed flush fronted arrangement permitting the grouping of widely differing starter types in uniform formation, thus allowing tailor-made switchboards to be assembled from standard units.

It is not surprising, therefore, that an ever-increasing number of engineers are relying on "Belmos" to meet their switchgear requirements.



★ *35 years' service to the Electrical Industry.*



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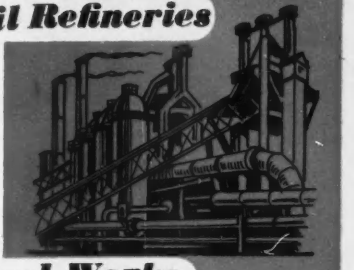

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Ashathene is manufactured in all standard sizes and is also available in S.W.A. & D.W.A. classes. Please send for leaflet TL/1001 and price details.

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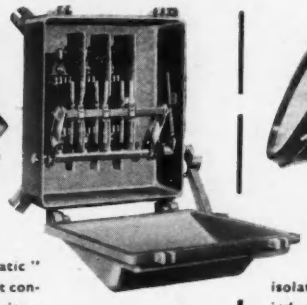

Typical of the range of Revo floodlights for tungsten, mercury or sodium lamps

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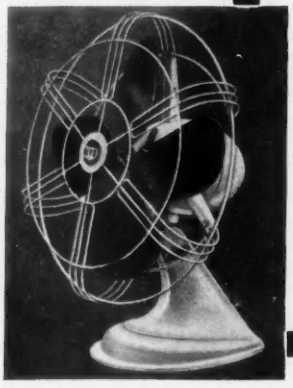
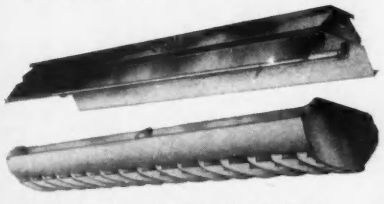
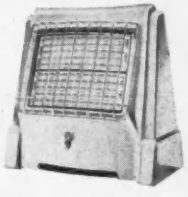
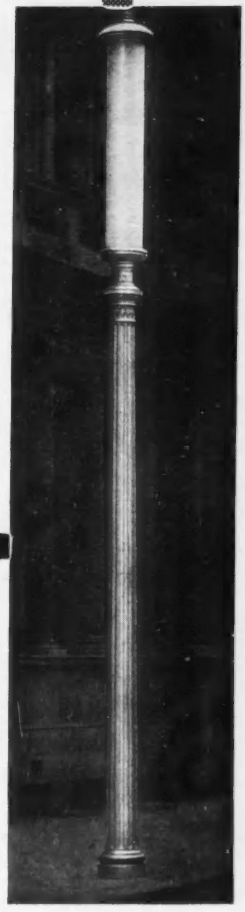




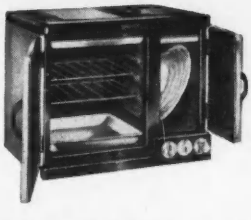
An industrial trough type reflector fitting, together with a decorative model, both using 4 ft. or 5 ft. tubular fluorescent lamps



The Revo "Dolphin" electric fire in vitreous enamel with B.S.S. guard



The range of Revo electric fans includes models for desk, wall and ceiling mounting.



(left) The Revo "Peerless" cooker, designed for table use or with special stand, incorporates a roomy oven, plate warming compartment, grill-boiler and 8" boiling plate.

(right) This "Festival" fluorescent lantern and cast iron column is representative of the wide range of Revo street lighting equipment

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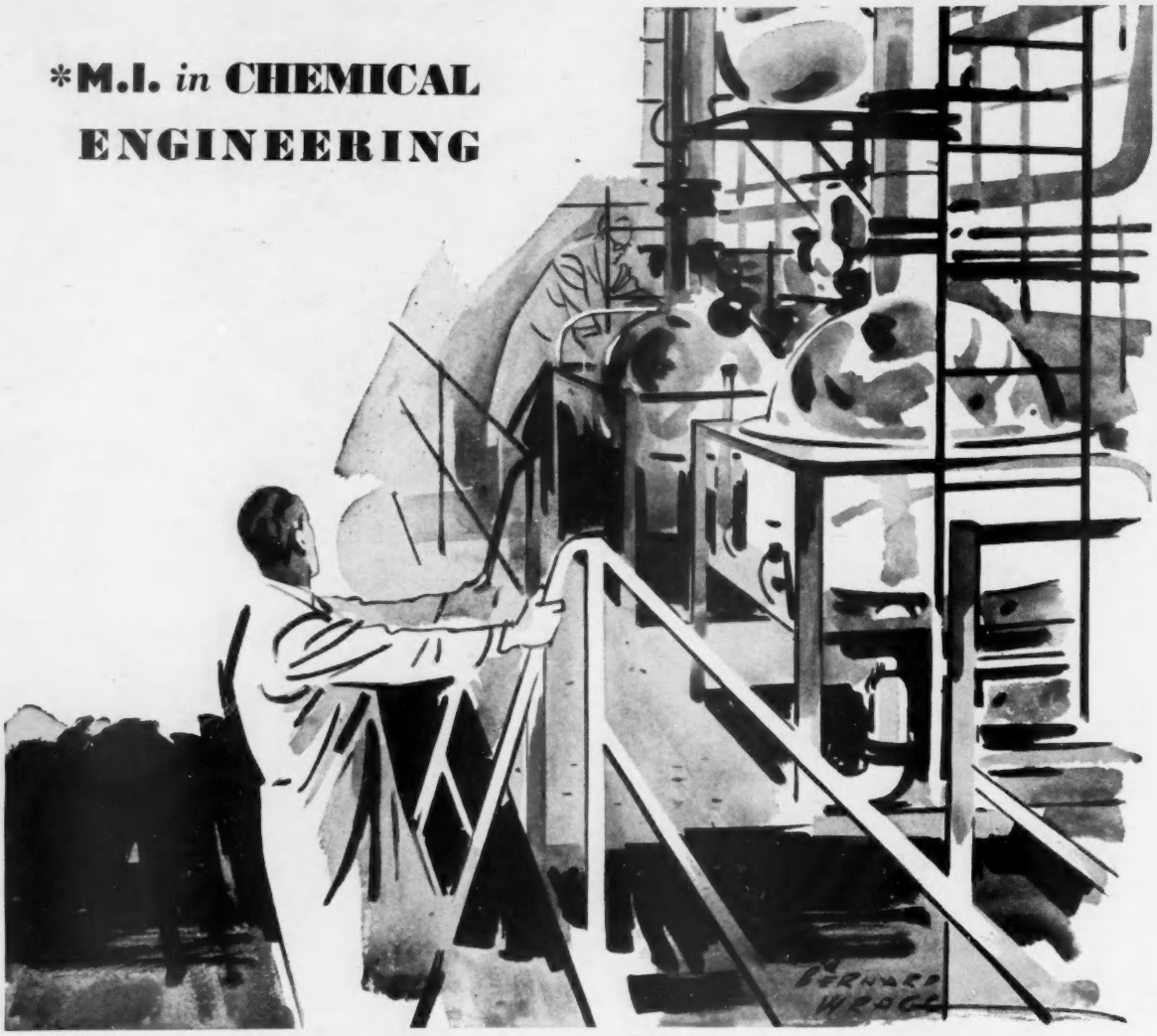

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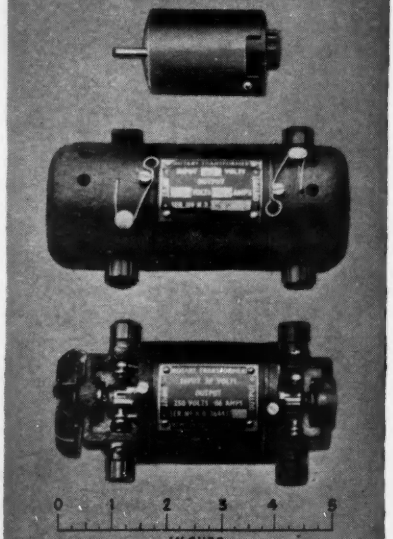

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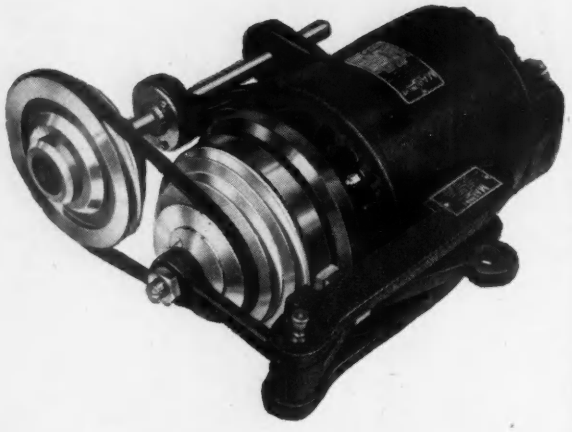

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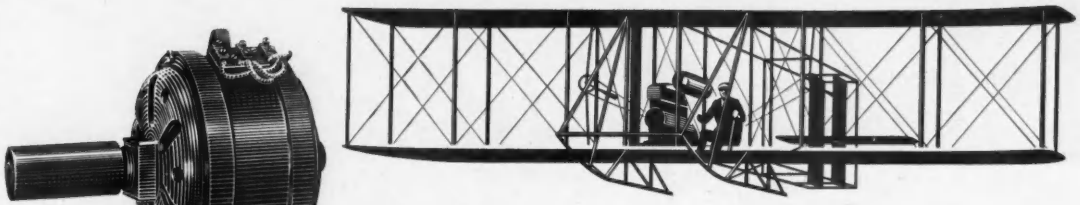

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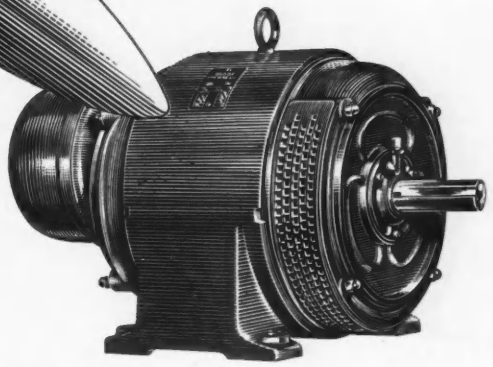

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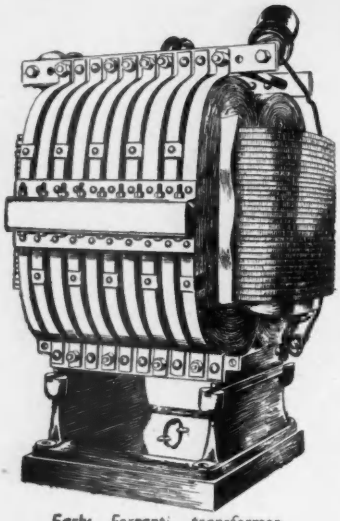

Early Ferranti transformer built in 1891 now in the Science Museum, S. Kensington

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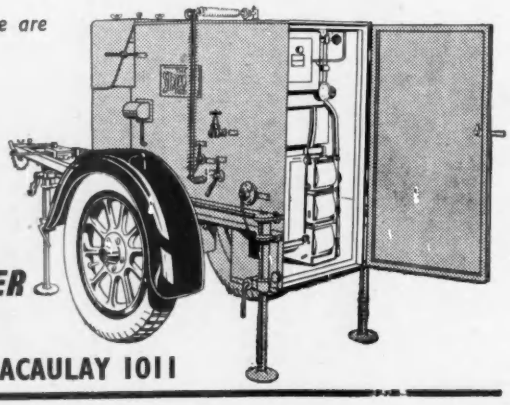

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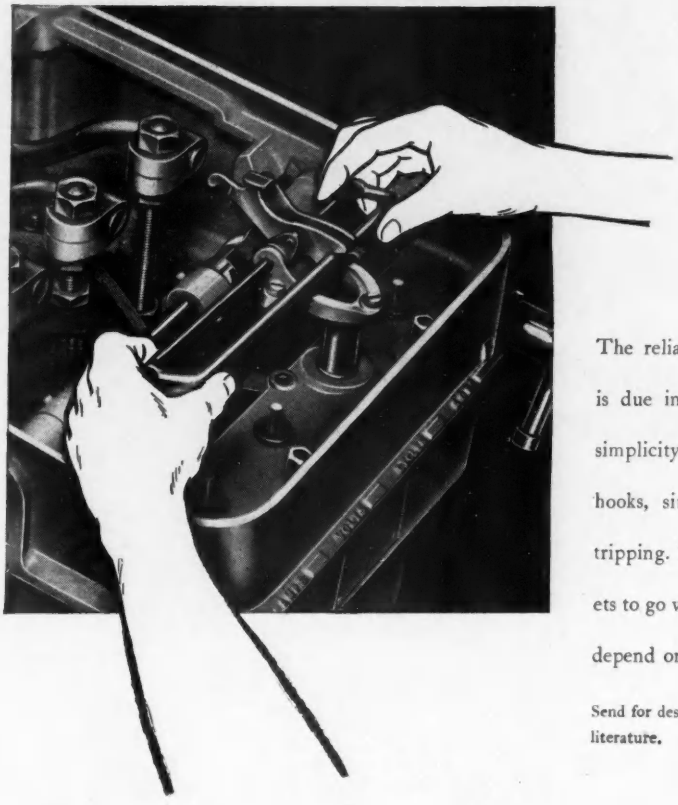

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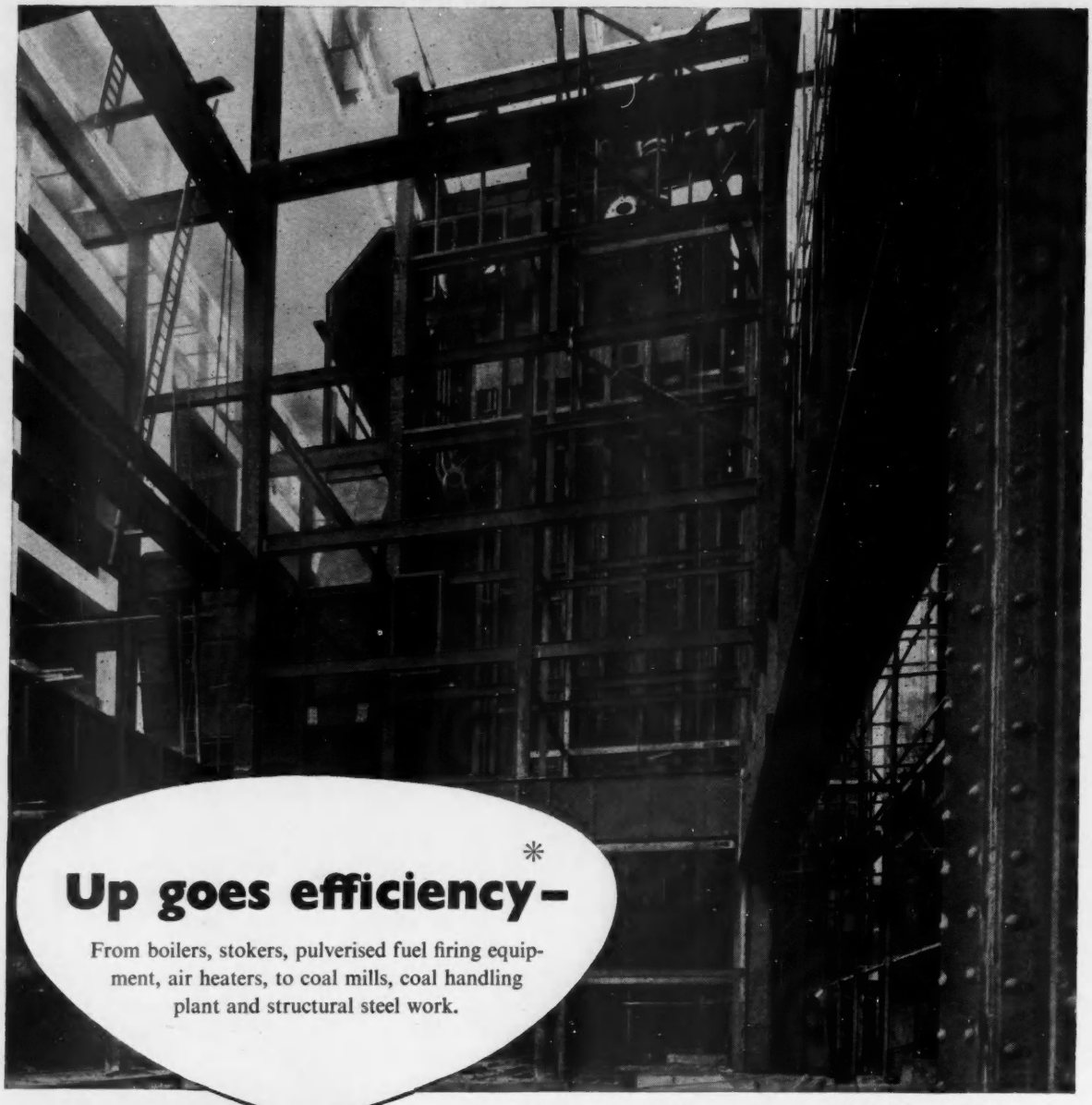

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ELECTRICAL TIMES

ESTABLISHED 1891

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SUBSCRIPTION RATES

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POWER FOR NUCLEAR PRODUCTION

Relatively little has been heard of the production side of the country's atomic energy effort. The spotlight of publicity has played in preference upon the glamour of the Harwell research effort and on the wonder of its end products, the atomic bomb and the power producing pile. So the publication this week of a book describing the work of the Atomic Energy Production Division provides a timely reminder of all that comes between: of the many engineering skills that have been drawn upon to make nuclear materials available in industrial quantities. Not that this story reveals any secrets. Rather, it fills in the gaps left by the outline of bare facts that have been released from time to time about the work at the great establishments on our north-west coast. For the electrical engineer, this added detail has two features of special interest, one for the present and the other relating to the future: the large scale on which electricity is used in the atomic factories, and the industrial health aspect of the work with nuclear fuels. A parliamentary committee was told two years ago that the expenditure on electricity would " probably astonish " them, and more recently Sir Christopher Hinton, the leader of the Production Division, has spoken of heavy expenditure on electric power required by the blowers in the existing air-cooled piles at Windscale. The new account underlines these statements with its frequent references to the scale on which electricity is used not only in blowers and pumps for a variety of purposes, but also for a range of auxiliary applications stretching from electric furnaces for melting aluminium to the incongruity of domestic vacuum cleaners in use on a foundry floor. The atomic energy industry has an appropriately voracious appetite for the electric energy it will one day help to generate.

STATION SAFETY PROSPECTS

The second point of special interest in this new publication on atomic energy is related to this probability that the power station engineer of the future will be working with nuclear reactors. For a number of reasons the fear that atomic energy must be dangerous has become firmly fixed in the minds of many people. So much has been heard of the effects of radiation that the idea has grown up that working with radioactive materials must expose a man to quite abnormal risks. Such fears are countered by a double reassurance in this new story. Running throughout the description of the various plants now

operating, there is the underlying approach that they are quite normal factories, employing large numbers of men and women, and demanding from them only close obedience to relatively simple safety regulations. More explicit is the chapter on industrial health in these establishments. This shows that the danger that certainly exists can be and is brought under complete control even when accidents occur: and the details given suggest that there is nothing mysterious about the steps necessary. On a basis of accident rates, indeed, atomic energy would appear to offer one of the safest of industrial employments! If this can be achieved in the complex circumstances of a production factory, it seems reasonably certain that the power station personnel of twenty years hence will face no greater danger in their everyday employment than their predecessors.

EXPERIENCE ORGANISED FOR EFFICIENCY

Because electricity is so versatile, it is seldom a simple matter to decide how to use it most efficiently: there are usually several possibilities to choose from. For the large consumer, who has his own electrical staff or habitually employs consultants, this offers little problem, while for the domestic consumer general advice is easily obtainable from contractor or service centre. In between lie many commercial undertakings and the small factories employing about 50 people in which a large proportion of this country's manufactured goods are produced. For such establishments the question of how best to use electric power is a problem not always easy to answer, and although manufacturers of electrical plant or the engineers of the local supply authority are usually willing to help, the managements concerned frequently lack sufficient initial electrical knowledge to approach them with a specific query. One useful way of helping such consumers that promises success has been evolved in the Merseyside and North Wales area, where a Productivity Group was formed a short while ago, to concentrate the experience of the Board's commercial staff in problems of industrial application. Now, as a result of discussions with the local branch of the National Union of Manufacturers the Group is making an offer of individual help to all small manufacturers in the area. Approaches such as this offer a valuable opportunity of promoting the best use of electrical energy in increasing productivity.

MADE FOR MAINTENANCE

Bound with this issue of the ELECTRICAL TIMES is the first number of *Industrial Maintenance*, a special section which has for long been planned and whose realisation has been facilitated by our new format. Articles written for the electrical maintenance engineer are no strangers to our columns, but inevitably they have had to compete with the many other claims on space made by the news of all sections of the electrical industry. This, we have felt, has not fully met the needs of our readers engaged in the care of electrical equipment in all kinds of factories. In many cases they are lonely men. As often as not, they have no superiors with whom they can discuss their technical problems, nor are their ideas given a full examination, whatever the possible savings their implementation might bring about. It is to serve such engineers that our new venture is intended. Through its monthly pages we plan to spread the ideas and techniques successfully developed in different industries and various parts of the country. The accent throughout will be on practical problems and practicable solutions, for the solace of theory has little place in the maintenance workshop. We shall welcome correspondence from our readers; notes on their problems and stories of their achievements. *Industrial Maintenance* is tailored for factory electrical engineers and technicians. We invite them to make it their own.

SAFETY FROM SPARKS

Comparison of the new Ministry of Fuel Memorandum on the testing of intrinsically safe electrical apparatus and circuits with its predecessor gives a brief but succint summary of the advances made in this technique since the original publication in 1946. Primarily, the principle has become sufficiently well known in its extended sphere of application—factory as well as mine—for the mass of explanation and illustrative examples to be largely dispensed with; and of more practical importance perhaps, the list of gases for which it is possible to issue official certificates of intrinsic safety has been significantly extended, and there is a promise of further additions to come. This is an important advance, which must greatly expand the range of application of intrinsically safe equipment in industries where explosive conditions exist. The technique offers the advantages over flameproofing that an intrinsically safe circuit should be devisable for use with any gas or vapour, and that instruments and control equipment complying with certification requirements can be built at a much lower cost than flameproofing would demand.

CENSUS ALTERNATIVE

Any official form takes a measure of time and effort to complete. That has been the experience of all of us in recent years, and we know that even in the personal sphere the effort required may be considerable, and the time ill-spared. It is no wonder, then, that industry seldom looks with a friendly eye on that regular feature of Government planning activity, the Census of Production and Distribution. Objections and criticisms are many but they are rarely constructive; so a memorandum which did offer an alternative seemed to deserve attention when it came to our notice recently. Sponsored by the Association of British Chambers of Commerce it suggested as an alternative to forms and detailed enquiries, better use of the statistical data and records maintained by most reputable trade associations. There are many difficulties in the way of adopting such a suggestion: trade associations are not all-embracing, while it might prove difficult to obtain information in the form required, so as to make possible comparisons between industries. Yet for all this, provided the information is required principally for the purpose of forward economic planning, the scheme merits further examination. It appears to offer some hope of more up-to-date figures, and it would probably mean information of comparable use obtained at a distinctly lower cost.

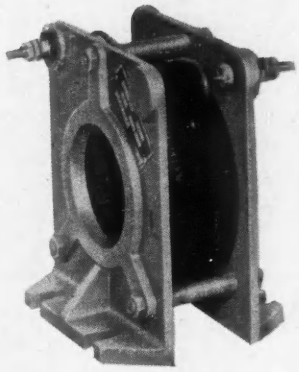
Meteor

Estimating the Overload Performance of Current Transformers

A METHOD OF DERIVING APPROXIMATE VALUES FOR UNITS ALREADY INSTALLED

By A. HOBSON, M.SC., A.M.I.E.E., MEM.A.I.E.E.

THE approximate performance of protective current transformers on heavy overloads may be determined from the results of simple tests carried out on the secondary winding. It is not necessary to have access to the primary, which makes the method particularly useful when the transformer is already built into switchgear, and furthermore the tests may be performed on site without the need for provision of a special heavy current supply.



Typical ring-type current transformer

Test Preliminaries

The first essential, after making sure that the primary circuit is open, is to measure the magnetising current taken by the secondary for various values of applied secondary voltage. The connections for this test are shown in Fig. 1. A sine-wave voltage should be used, which of course results in a non-sinusoidal current, and the instruments should, therefore, measure r.m.s. values. Care must be taken to ensure that the voltage drop in the ammeter is only a small proportion of the applied voltage. The test should commence at perhaps 2 or 3 volts and the applied pressure increased in steps until the current reaches about twice the rated value for the winding. This will generally be 10 amps, since most current transformers have 5-amp secondaries, and the flux density at this point should be well above the "knee" of the magnetising curve for the iron. When saturation is approached the current begins to rise very sharply and the increments of voltage should be made smaller to obtain a good curve. The maximum voltage may be anything from about 10 volts to upwards of 100 for a 5-amp secondary, depending on the number of turns and the dimensions of the core.

The next step is to determine the impedance of the secondary circuit under working conditions, because this decides how much current will flow for any particular value of induced voltage.

The types of current transformer for which the overload performance requires to be known are generally used for balanced protection. Fig. 2 shows one method of connection employed for a 3-phase 4-wire system, in which the neutral and line transformer secondaries are joined at the terminals of the relay. Under balanced conditions there is no current in the relay and the voltage across its terminals is zero. Thus the secondary circuit impedance of each current transformer consists simply of the resistance and leakage reactance of its own winding plus the resistance of its leads to the common point.

This brings in an important difference between ring type current transformers and those having an incorporated primary winding. The ring transformer secondary is usually distributed evenly around the whole core, so that its leakage reactance is negligibly small. Consequently it is only necessary to measure its d.c. resistance and to add that of the leads.

Leakage Reactance

On the other hand the leakage reactance of the secondary of a wound primary transformer is considerable, and as it is a difficult quantity to measure the best that can be done is to assemble all of one's knowledge of the particular circumstances and then to make a judicious guess. This is not so serious a drawback as might at first be thought, because the reactance and resistance, being mutually displaced by a quarter period, must be added vectorially, and their vector sum is a good deal less than the arithmetic total.

In the author's experience the leakage reactance often lies between about 50 and 100% of the d.c. resistance, indicating that the secondary impedance may generally be taken to be about 1·1 to 1·4 times the resistance. If the higher multiple of 1·4 is chosen the calculated performance of the current transformer will tend to be rather worse than the true performance under overload conditions, thus erring on the side of safety.

For the present calculations a ring transformer with a purely resistive secondary will be assumed. This covers a great many practical cases and leaves the allowance for

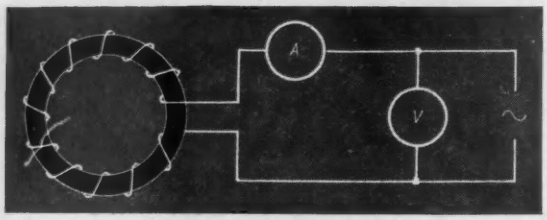


Fig. 1. This schematic circuit shows the connections for an open-circuit test of a current transformer

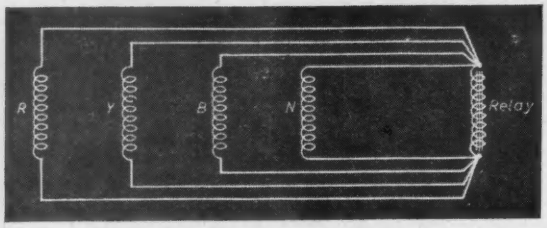


Fig. 2. The use of current transformers in balanced protection is illustrated in the above diagram

leakage reactance in wound type transformers to be made according to individual circumstances.

Basic Theory

If the resistance of the secondary circuit is known, then the secondary current for any particular value of induced voltage may be found from Ohm's Law. The magnetising current corresponding to the induced voltage, which has already been measured, is then the error of the transformer for that secondary current, enabling the primary current to be estimated.

It will be assumed that the magnetising and secondary currents may be added arithmetically to give the equivalent primary current. This is not true, of course, because the vectors are generally not in phase with each other, and the ratio errors calculated in this way are consequently greater than the real values. What is more, the relative phase positions change continually over the whole range of primary current, but the above assumption is often made when dealing with protection current transformers and the results are considered to be sufficiently accurate for most practical purposes. If the actual turns ratio is not known, the ratio marked on the nameplate may be used in calculating the primary current.

The equations are:

$$I_s = \frac{e}{r_s + r} = \frac{v + i_m r_s}{r_s + r}$$

$$I_p = N\,(I_s + i_m)$$

$$\text{Ratio error } \% = \frac{100 i_m}{I_s + i_m}$$

where r_s = secondary resistance, r = leads resistance, i_m = magnetising current, v = secondary terminal voltage (producing i_m), e = secondary induced voltage, N = turns ratio, secondary to primary, I_s = secondary current, I_p = primary current.

In Table I a complete example is worked out for a 400/5 amp ring transformer with 80 secondary turns and an internal resistance of 0·4 ohm. All the steps are given for clarity. The first two columns give the results of the magnetising current test. An examination of the figures shows that the "knee" of the curve begins at about 25 to 30 volts, after which the current rises rapidly for comparatively small increases in the applied voltage, indicating that the core is nearly saturated. The remaining figures were worked out from the test results using the above formulae, assuming the resistance of the leads to be 0·5 ohm.

In the last column the ratio error is calculated as a percentage of the primary current. When the error is small, very nearly the same answer is obtained whether either the primary or secondary current is used. With large errors, say 5% or more, there is a considerable difference between the secondary and equivalent primary currents and it is important to choose the right method of expression. Here the error is to be plotted to a base of primary current and must therefore be given in terms of that current for the curve to have a proper meaning.

Fig. 3 is the primary/secondary current characteristic. The graph is straight until saturation is approached and then breaks away from linearity owing to the big increases in magnetising current.

A much better way of expressing the performance is by means of the ratio error characteristic in Fig. 4. Here the "break away" point is much more sharply defined and is clearly seen to be a little less than 3,000 primary amps.

Fig. 3. Shown below is a typical overload curve for a 400 to 5 ratio current transformer taken up to a limit of 5,300 primary amperes

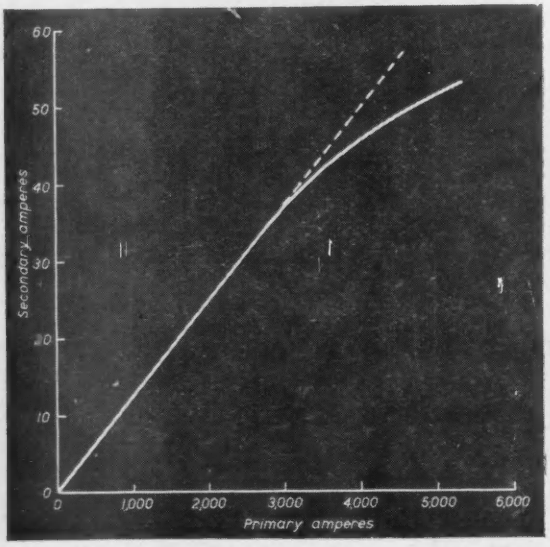
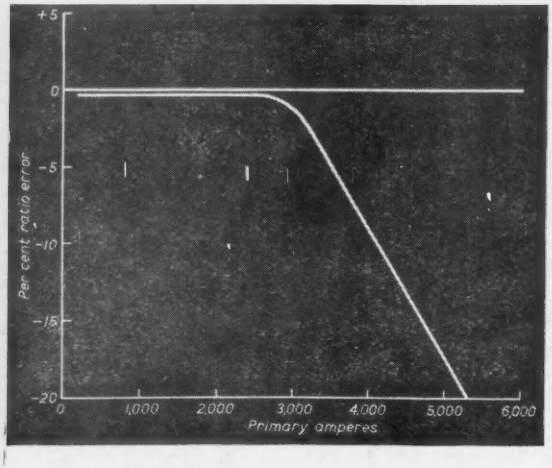


Fig. 4. The overload ratio error characteristic of a 400 to 5 ratio current transformer, over the same range as the overload curve is shown graphically in the sketch below



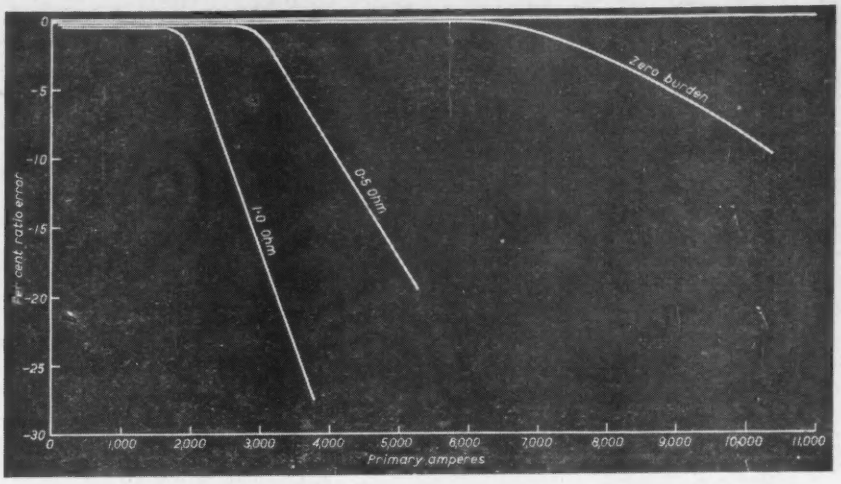


Fig. 5. This series of curves shows three ratio errors for a 400 to 5 ratio current transformer with three different burdens of zero, 0·5 and 1·0 ohms. Note the widely differing "breakaway" points

Change of Burden

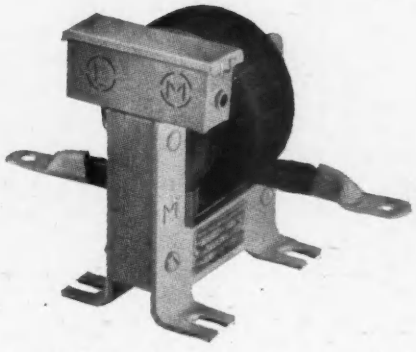
If the external burden is changed each particular induced voltage corresponds to a new value of secondary current and an entirely different curve is obtained. Increasing the burden reduces the current, giving greater errors and causing saturation to begin at a lower value of primary current. Reducing the burden has the opposite effect.

Three separate ratio error curves for the above 400/5 transformer are given in Fig. 5, the external burdens being zero, 0·5 and 1·0 ohms. The "break away" points are all different, being about 6,500, 2,800, and 1,700 amps.

Balancing Conditions

The successful balancing of current transformers is a fairly simple matter as long as they are working well below saturation. The errors are then quite small and the "spill" current in the relay is negligible. When saturation is approached the errors of the individual current transformers become very large, and the differences between them are greatly magnified. It is then very difficult to secure good balancing, even with transformers of identical design, unless the cores have been carefully matched for both quantity and magnetic quality. A small variation in core section shows up very prominently at saturation densities. Ideally, then, current transformers should be designed so that they remain unsaturated up to the highest current that can conceivably occur in that part of the system, and the burdens on a set of transformers should be equal.

It sometimes happens that the ideal is difficult to attain, as for instance in existing switchgear where the protection is out of date and the current transformers cannot be replaced. It may be found that one or two of the transformers have to supply other burdens, such as ammeters and overload relays, in addition to the balanced protection. The consequence is that the transformers with the greater burdens saturate earlier than the others, with the risk of operation of the balanced protection on through faults. In such cases an equal burden connected in the secondaries of the remainder will help to restore the balance.



An example of a wound primary current transformer

TABLE I. CALCULATION OF OVERLOAD PERFORMANCE OF A 400 TO 5 RATIO CURRENT TRANSFORMER.

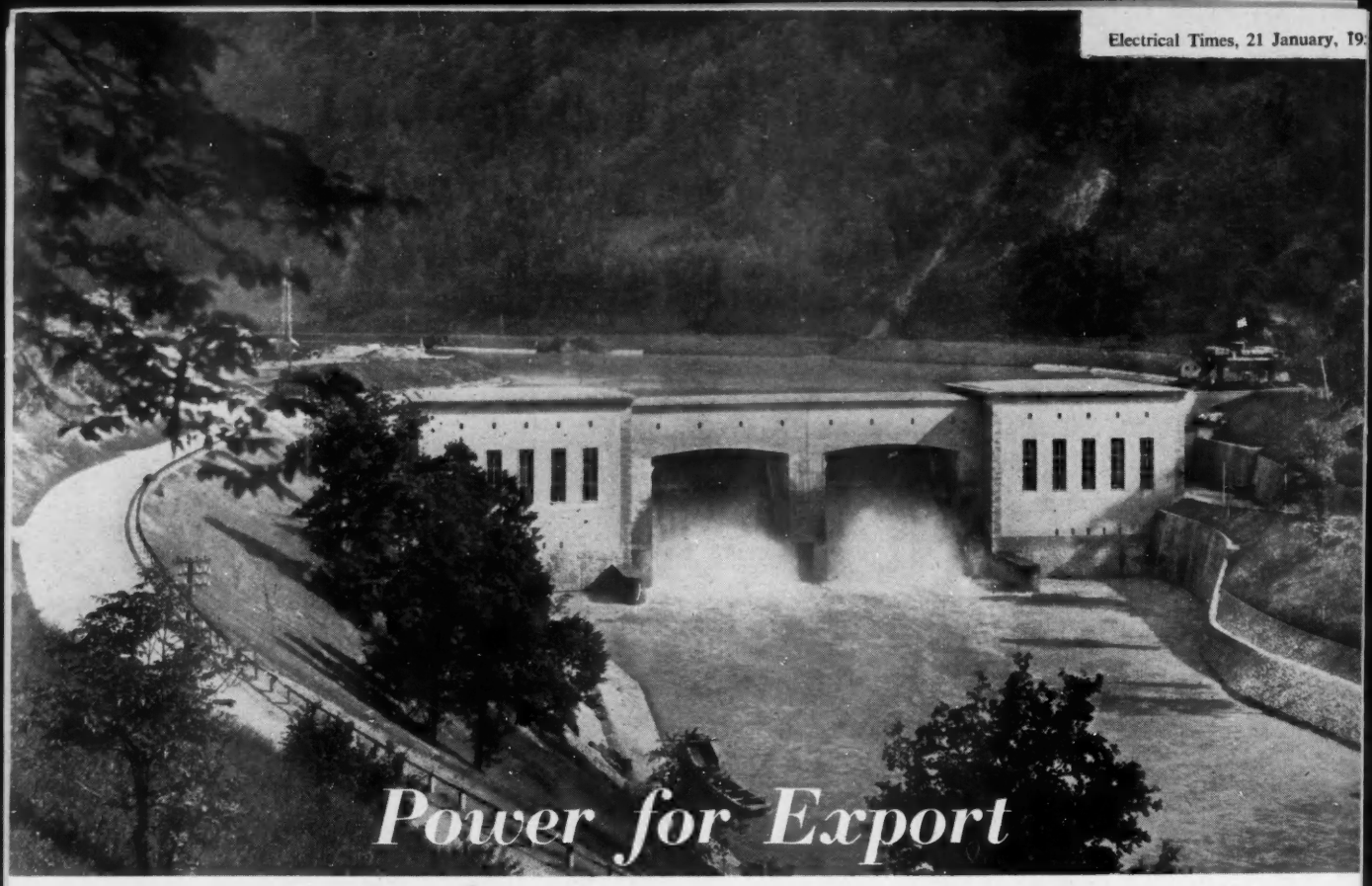
Mag. Current i_m	Terminal Volts v	Internal p.d. $i_m.r_s$.	Induced emf 'e'	I_s	I_s+i_m.	I_p	%Ratio Error
0·017	5	Ignored	5	5·56	5·58	446	.0·3
0·028	10	"	10	11·11	11·14	890	0·25
0·034	15	"	15	16·67	16·71	1340	0·20
0·048	20	"	20	22·22	22·27	1780	0·22
0·07	25	"	25	27·8	27·87	2230	0·25
0·16	30	"	30	33·3	33·46	2680	0·48
0·41	32·5	0·16	32·7	36·3	36·71	2940	1·12
1·2	35	0·48	35·5	39·4	40·6	3250	2·96
3·0	37·5	1·2	38·7	43·0	46·0	3680	6·5
5·6	40	2·2	42·2	46·9	52·5	4200	10·7
9·8	42·5	3·5	46·0	51·1	60·9	4860	16·1
13·0	43·5	4·2	47·7	53·0	66·0	5280	19·7

Note: In this table $e=v+i_m r_s$; $I=e/(r_s+r)$; $I_p=80\ (I_s+i_m)$ and % Error Ratio $=100\, i_m/(I_s+i_m)$.

Frequency Modulation Recommended

THE use of frequency modulation for very high frequency sound broadcasting in Great Britain is recommended by the Television Advisory Committee in its second report, published on Monday (H.M.S.O. 1s.). The committee was considering the most suitable method by which sound broadcasting at frequencies higher than those used at present could be introduced, supplementary broadcasting service being necessitated by the severe interference now met on medium and long waves due to overcrowding.

The frequency range recommended for v.h.f. broadcasting should be from 88 to 95 mc/s, which should not impair development of television if recommendations in the first report are carried out. If f.m. is adopted, the committee understands that the B.B.C. is ready to start immediately on the construction of transmitting stations. It should be introduced on a "fair scale" to ensure receiver production for a good market to assist export trade. But whether the v.h.f. service is to have national coverage or merely re-inforce the existing lower frequency services, the recommendation of f.m. still holds good.



Power for Export

Hydro-Electric Development in Austria with particular reference to the Enns river Scheme

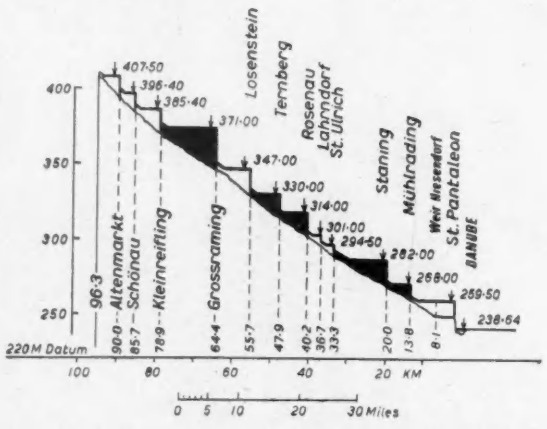
By Dr. E. KONIGSHOFER*

IN an article the "Power Potential of Europe" which was published in the ELECTRICAL TIMES of 19th July, 1951, it was shown that Austria was developing large hydro-power resources which are surpassing any possible increase in Austria's own energy requirements. In the article referred to, the opinion was ventured that Austria was called upon to function as a "Power Bank for the Continent." In this connection it is to be noted that Austria has even reserved certain undeveloped hydro-power resources for export purposes.

On 1st December, 1952, leading power supply undertakings of Austria, Germany, France and Italy founded the "Study Company for the Development of Alpine Water-Power in Austria Ltd." which is investigating future potentialities and preparing a development plan for export power plants in Austria in the interest of all the participating countries. Furthermore, some Austrian power supply companies have filed an application with the International Bank for Reconstruction and Development for credit to be used for the completion of the power plant group "Reisseck-Kreuzeck," work on which is progressing but slowly, and for the subsequent intensification of the energy exchange with Italy.

In "Power Potential of Europe" some of the more important Austrian hydro-power resources reserved for export purposes were enumerated. These schemes envisage the creation of large storage reservoirs so that in times of low water supply, and especially during winter months a reliable power production can be guaranteed.

The present power schemes developed by Austria from her own funds, and with the help of ERP credits are designed to cover domestic requirements of electric energy. One of these projects is the "Glockner-Kaprun" which is being constructed in two parts; the Main Stage and the Upper Stage. The Main Stage, comprising the Wasserfallboden reservoir with the Limberg dam, as well as the power station Kaprun, has been completed. The reservoir has a net capacity of 83·6 million cubic metres, (18,400 million gallons); the net head is 856 metres (2,800 ft) and the installed capacity of the power station Kaprun 200 MW. Some 460 million units are produced annually, 80% of these in the winter months. Work on the Upper Stage is at present in progress.



In our heading block we show the Grossraming station (Fig. 1). The line drawing illustrates the Enns river profile (Fig. 2)

**Dr. Konigshofer is with the Osterreichische Elektrizitatswirtschafts Aktiengesellschaft (Verbundgesellschaft).*

While all of the above-mentioned parts of the large power plant group "Glockner-Kaprun" are located on the northern slopes of the Hohe Tauern mountain range, water is also diverted from the Moll river, south of the Hohe Tauern, to the Mooserboden reservoir of the Upper Stage by way of a tunnel, 11·6 km (7·15 miles) long. Annual power production of the Upper Stage will amount to 140 million units of which 82 million will be generated during the winter months.

Inn Exploitation

Two more important projects under construction are Braunau, on the Inn river, which forms the border between Austria and Germany, and the Danube run-of-river plant at Jochenstein. Both power plants are utilising border rivers and are, therefore, jointly erected by Austria and Germany. Each of the two riparian states will obtain half of the electric energy generated by these stations. While Braunau will have an installed capacity of 96 MW yielding 513 million units per year, the figures for Jochenstein—which will be the largest run-of-river plant in Europe—are 140 MW installed capacity and 940 million units annual production. Moreover, it has recently been decided to construct a large plant at Ybbs-Persenbeug, on the Danube at a medium distance from Vienna. There it will be possible to install about 150 MW and to produce 1,000 million units per year. Further power sites to be developed for covering domestic requirements are located on the Enns-river in Upper Austria, at Prutz in Tyrol, at Hieflau in Styria and on the Kamp-river in Lower Austria. Among the developed and operated stations the power plants of the "Vorarlberger-Illwerke A.G." on the Ill river in Vorarlberg may be mentioned, which having an installed capacity of about 350 MW, are producing about 1,000 million units per year, the major portion of which is transmitted to the Rhineland. Construction plans for an additional large station are being prepared.

The Enns river Scheme

The recent completion of a new generating station in the chain of power plants on the Enns river offers an appropriate occasion to include here a general survey.

The Enns is the largest river which runs exclusively through Austrian territory. It is 254 km (158 miles) long and flows through the Federal provinces of Salzburg, Styria and Upper Austria. In its lower part it forms the border between the Federal Provinces of Upper Austria and Lower Austria. Over a distance of 95 km (59 miles) the available head in 170 metres (560 ft), the average annual water flow amounting to 220 cu m/sec (7,750 cusecs). Its lower course is especially suited for the construction of a chain of river-storage plants which have been under construction (see Fig. 2).

It appeared, from preliminary studies, practical to utilise this section of the Enns in 12 stages and to provide for each stage a small reservoir which could be used for intermediate storage operations (Fig. 3). The backwater of each reservoir reaches up to the preceding dam with the exception of the Staning section (Fig. 2) in which case it extends only to the downstream end of the city of Steyr. While the plants at Grossraming, Ternberg, Staning and Muhlrading were completed some time ago, Rosenau has only recently gone into operation with one of the two generators.

Station Sizes

The largest station in the Enns river Power Plant Group is Grossraming shown in Fig. 1, which provides the relatively high head of 23 metres (74 ft) on the average. The utilisable water volume amounts to 1·19 million cu m (262 million gallons) for a fall in water level of one metre (3·28 ft). Two generating sets with a total capacity of 54 MW have been installed. Two transformers rated at 31·5 MVA each, step up the voltage of the generating units

Fig. 3. Map of the Enns river district showing the location of the power station chain

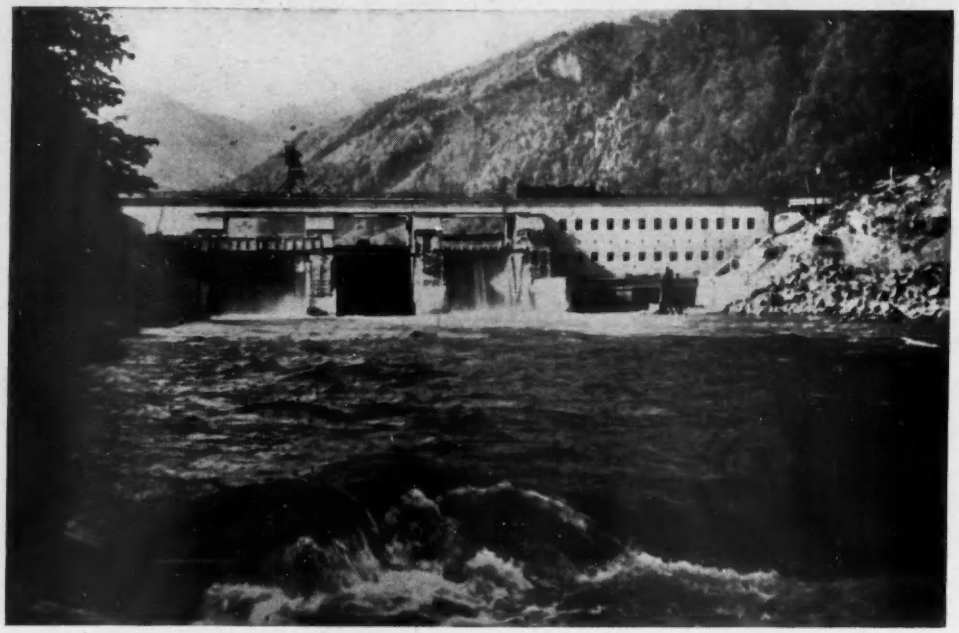


Fig. 4. Ternberg station on the Enns river is shown on the left. This station was completed some time ago and is now in full production

from 6·3 kV to 115 kV. The backwater basin extends over 12·6 km (7·85 miles) upstream. Architecturally an especially attractive solution has been found and this plant is among the finest hydraulic construction in Europe.

Next to Grossraming there is, further downstream, the Losenstein plant which is ready for construction and which will be the next stage to be developed.

Following Losenstein is Ternberg with a storage capacity of one million cu m (220 million gallons) for a fall in water level of 1·5 metres (4·9 ft). This plant is shown in Fig. 4. Two generators with a capacity of 30 MW will be installed.

The next station is Rosenau, shown in Fig. 5, where supplementary work is being carried out and the second generating unit is being erected. The utilisable water volume of the intermediate storage basin amounts to 0·85 million cu m (187 million gallons) for a fall in water level of one metre, and the total capacity of the two sets amounts to 25 MW. Downstream of the city of Steyr there are the completed Staning and Muhlrading stations while the plans for the St. Pantaleon plant have been studied and finalised. The larger of the two completed plants, viz. Staning, has a reservoir with a net capacity of 2·27 million cu m (485 million gallons) for a fall in water level of 1·2 metres (4 ft) and three generating sets with a total capacity of 33 MW are installed. In Muhlrading four generating units have been erected with a total capacity of 23 MW, and here the utilisable water volume is 1·3 million cu m (286 million gallons) for a fall in water level of 4 ft.

The above five stages which either have been or are being completed possess a production potential of 810 million kWh in a normal year of which some 300 million units will be generated in winter. The output amounts to as much as 15% of Austria's energy production.

This scheme shows how the maximum exploitation of a river may be obtained by the use of several small reservoirs when major storage facilities are difficult.

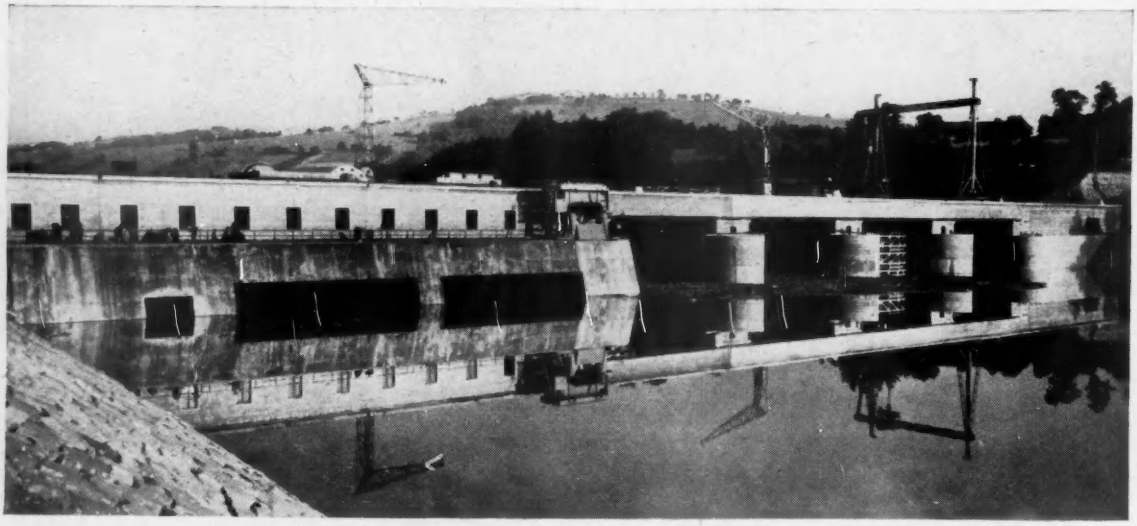


Fig. 5. The Rosenau station is now being extended. Capacity of the two sets installed will finally amount to 25 MW

READERS' VIEWS

Correspondents writing under a pseudonym are asked to submit their names in confidence to the Editor

Low Voltage for Schools

AS an electrical engineer with a few years' experience on school installations, I am surprised at the decision of Chester Education Committee to supply schools at 110 volts. I agree with the remarks in the editorial of ELECTRICAL TIMES dated 7th January, that in schools electricity loses much of its danger, but with this proviso, the installation should be done to the specification and under the supervision of a competent electrieal engineer, and not to the ideas of an architect, quantity surveyor or even the borough engineer and surveyor. It is not the contractor's job to go through the specification with a fine tooth comb looking for the less obvious mistakes of those gentlemen.

I have recently been astonished at the extent of such incompetent activities; for example architects asking local authority engineers to vet schemes they themselves have prepared for other authorities, turning down 13 A sockets in housing because they are not readily obtainable at a leading chain store, deciding that quantity surveyors should do housing work because it was too unimportant for the engineers on the staff, sending a mixed mission of architects and quantity surveyors from a county authority to a nearby large local authority in order that the latter's electrical engineers could give them ideas on the electrical scheme, cutting electrical installations in houses to under 60% of the requirements of the Post War Building Studies, installing 7/·029 services from the main intake with 50 yard runs to single persons' flats and so on.

The time has come for all electrical installations in buildings to be designed to the specification of a competent electrical engineer, if installations, complying in respect of material and workmanship with the I.E.E. Regulations, are to be provided to give us a reasonable guarantee against shock and fire.

Architects should be legally prevented from accepting fees based on the electrical part of the work unless they are qualified to do this work, and they should be restrained by law from interfering with the electrical engineer in the performance of his duties.

I know nothing of the set-up in Chester, but I am writing in order that electrical engineers not engaged in installation work may be informed of the dangers that may face them, their children, and the general public.

Local authorities should set an example in this matter.

Ronald Croft,
GREENOCK.

* * *

THE confusion of mind shown by Megohm in his Notes dated 14th January deserves illumination.

Is the industrially used electricity of a more dangerous nature than that used by children in school? For many industrial organisations seem to think that it is desirable to reduce the voltage to fifty volts with the midpoint earthed for portable tools. Is it too much to expect some such protection to be given to small children? My experience is that voltage reduction will result in reduction of costs for I have found that 110 volt midpoint-earthed fed tools last far longer than the 230 volt fed tools. Field coil rewinds alone were reduced sufficiently to pay for all the electricity used by the small tools.

I should be pleased to learn from Megohm how earthing and fusing will help the child holding a drill who pulls on the flex, detaches the earth lead from the pin in the plug and causes the earth lead to come into contact with the phase pin.

He seems to think that low voltage will greatly increase the cost of the installations. I wonder why? A 5 amp plug will be adequate for any normal portable appliance so cable dimensions will not be changed and a single transformer at the main distribution board with its protection will be the only necessary addition. Surely that is not much on a large installation, certainly it will not put many of his fellow contractors in the super-tax class.

The domestic kitchen issue is just a bogey. I'd convert mine to 110 if I were not so lazy, in fact, I'd do the whole house and get the same light from an 80 watt lamp that I get from my 100 watt lamps and longer life too. I gather the Cheshire Education Department are not so lazy. I believe more people are electrocuted in homes than in industry but of course they can't claim compensation so less is done for their safety.

T. Emby,
BLOXWICH, STAFFS.

Statistical Analysis?

I READ with interest the article regarding the above in your issue of 31st December, 1953. The final paragraph at long last answers the query, viz.: *what use* is made of the many returns which are now considered essential!

I hope the "statistically minded drone" made due allowance for the "tea breaks" (official or otherwise) when computing these enlightening statistics.

W. O. Lofthouse,
WIMBLEDON, S.W.20

TESTING FOR INTRINSIC SAFETY

IN 1946 the Ministry of Fuel and Power issued for the first time Testing Memorandum No. 10, which gives information on the test and certification of intrinsically safe electrical apparatus and circuits. Last week a revision was published, dated December 1953, and this in future will govern the official testing of apparatus in respect of intrinsic safety. Apparatus designed for use in mines subject to the Coal Mines Acts is concerned, together with that intended for use in premises under the Factories Act 1937.

One change from the previous edition is at once apparent —much of the explanatory detail has been excluded. Further to this, the range of gases for which tests can be conducted has been extended, and the full list is now: methane, pentane, hexane, heptane, butane (calor gas), benzene, cyclohexane, cyclohexene, acetone, carbon monoxide, hydrogen, and coal gas (town's gas), coke-oven gas, blue water gas. Testing of electrical shot-firing apparatus, hitherto included in this memorandum, is now to be found in Testing Memorandum No. 5.

The Memorandum lays down that application for a test with a view to certification may be made either by the manufacture of the apparatus, or if it is a foreign product, his U.K. agent. Applications are required to be accompanied by a list of particulars dealing with intended use, etc., and by a technical description of the apparatus together with, a set of drawings. It is required that applications should be made in writing to The Secretary, Ministry of Fuel and Power, Safety and Health Division, Thames House South, Millbank, London, S.W.1, or to the Senior Electrical Inspector of Factories, Factory Department, Ministry of Labour and National Service, Grosvenor Garden House, Grosvenor Gardens, London, S.W.1. The authority to be approached depends on the intended use and a £3 registration fee must accompany each application.

Heavy Duty Contactor Contacts

A REVIEW OF PRESENT KNOWLEDGE AND THE NEED FOR RESEARCH

By H. W. BAXTER * B.SC., M.I.E.E.

IN a review of a technical nature, and especially one that indicates a lack of fundamental knowledge, one is tempted to justify future research on commercial grounds. If such justification were needed in this case, it is to be found in the size of the control gear industry, the products of which are connected in some way with the existence of almost every individual in the country. In nearly every factory, power station, coal-mine or train, to mention only a few applications, contactors are to be found. An important part of a contactor, and one about which comparatively little seems to be known, is the contact, for it has to work under a wide variety of conditions which, in certain applications, may be very onerous, and it is with problems associated with heavy-duty contactor contacts that this review is concerned.

There appears to be no sharply defined line of demarcation between what are termed respectively "light-duty" and "heavy-duty" contacts. The term "light-duty," as applied to contacts, usually denotes contacts that carry a small current in a low voltage circuit; and since the contact force is often small and low contact resistance is usually of paramount importance, the contacts are made of noble metals. They may be considered as operating without significant arcing and, although there may be material transfer from one contact to the other, the net loss in weight over a period of frequent operation is small.

When the conditions are such that there is significant arcing and the consequent loss in weight masks material transfer, the duty imposed on the contact may be classed as "heavy-duty."

The current ratings of heavy-duty contacts extend in practice from a few amps to about 600 A, but some manufacturers use several contacts in parallel for currents greater than 300 A. Air-break contactor contacts are used at voltages up to about 6 kV.

The operating conditions covered by B.S. 775:1938, range from continuous duty, in which the contacts may be closed for long periods, to severe duty, which involves 600 operations per hour; but higher rates of operation occur in some practical applications. Contactors must be able to make and break six to ten times their rated currents.

Because the rate of wear of heavy-duty contacts is relatively great, noble metals of the gold and platinum group are excluded, if only for economic reasons, but even if cost were not a primary consideration it is doubtful if they have the most desirable characteristics for this class of service. Silver is much used for contacts of relatively small current-ratings, and silver inserts are often fitted to large base metal contacts, but the use of copper is still widespread and it is probably the characteristics of this metal that determined the form of the majority of present-day contactor contacts.

Types of Contact

An early form of contact, which is still widely used for currents of up to several hundred amps, is shown in Fig. 1. The contacts perform a rolling motion, touching first at the tip and finally at the base. When the contactor is fully closed the current is carried at the base of the contact, and when the contactor opens arcing occurs only at the contact tip; or rather, that is what should happen if there is no contact bounce. Sometimes there is relative sliding between contact faces, the object being to rub off any surface film[1] that may have formed, and so reduce the contact resistance.

Fig. 2 (*a*) shows a simple form of butt contact that can be arranged to have neither rolling nor sliding motion; and Fig. 2 (*b*) shows a double-break butt contact that is widely used for small contactors. The contact surfaces of the latter are usually provided with a silver facing.

*Based on E.R.A. Report Ref. G/T 287, originally presented at a Convention on Electrical Contacts organised by the Institution of Electrical Engineers, East Midland Centre. The heading illustration shows a control board at the Trostre Works, Steel Co. of Wales.

Laminated contacts and blade-type contacts are not much favoured for contactors.

The material of the contact influences the rate of wear; this is discussed later.

Contact Resistance

It is unnecessary to discuss the theory of contact resistance in detail, but it may not be out of place to mention some of the practical aspects. It is well known that, because of surface irregularities, even apparently flat surfaces make contact at only relatively few points. The greater the contact force the greater the number of points that are in contact[2] and the lower the resistance. The effect is reversible provided that no part of the material is stressed beyond its elastic limit. It would seem that the elastic limit may be exceeded in practice, especially with line contacts and a large contact force, and thus there may be some plastic flow and a corresponding reduction of contact resistance. The contact resistance is related to the specific resistivity of the material provided, of course, that the surfaces are clean.

Past work by a number of investigators has led to the conclusion that the resistance between contacts is mainly a function of the contact force[3] and is almost independent of the apparent area of the contact surface. From this it might be inferred that a small contact will serve for large currents if the contact force is increased sufficiently, but in practice it is usual to increase the physical dimensions of the contacts for the larger currents and so obtain the additional benefit of improved heat dissipation.

A contactor may be closed for long periods and it is important that the contact resistance should not increase appreciably with time. Even if relative sliding between contact faces is used with the object of rubbing off surface films, the contacts should still be able to maintain a satisfactorily low resistance when they are operated infrequently.

Copper contacts that are closed and fully loaded for long periods may show signs of cumulative deterioration during the first few hours. The energy liberated at the contact raises its temperature. This causes oxidation of the copper to cupric oxide which, because of its high resistance, causes additional heating, with further oxidation and increase of resistance. The temperature does not, however, continue to increase, as Fig. 3 shows; there is a periodic fall in temperature and the cycle appears to repeat indefinitely. It has been suggested by B. W. Jones[4] that when the temperature is high enough there is a conversion of the cupric oxide to cuprous oxide, which has a lower resistivity, and hence the temperature falls. The temperature at which this occurs may be greater than that of the general mass of the contact; but the temperature of the contact gives no indication of the much higher temperatures that must occur at the relatively few points at which the current is carried. Apparently this theory has never been confirmed.

If copper and silver contacts are compared under otherwise identical conditions, it is found that silver has a lower contact resistance. If the contact surfaces are chemically clean, the difference in contact resistance may be small, but if the surfaces are tarnished, the difference may be appreciable.[5] Copper oxidises readily and may form cuprous oxide, which has a high resistance, or cupric oxide, which is practically an insulator. Silver does not oxidise under normal conditions, the usual tarnish on silver being silver sulphide; and although copper may form a corresponding sulphide, silver sulphide is unstable at a relatively low temperature; hence silver contacts can generally be relied on to have a lower contact resistance.

Effect of Operations on Wear

If the loss in weight of the contacts of a contactor that operates repeatedly under given conditions of voltage, current, power-factor, etc., is measured periodically and the results are plotted it will be found that, if the contacts are of copper, the curve will be of the form shown in Fig. 4, curve 1. There is an initial bend in the curve, after which it becomes straight; the slope of the straight part of the curve may be said to represent the rate of contact wear, since the initial bend accounts for only a small fraction of the life of the contacts. When the contacts are new the rate of wear is relatively small because the wear is between metal surfaces; but when the contacts become oxidized the oxide film is more easily removed and the rate of wear increases. This initial bend is also exhibited by other contact materials, including the sintered tungsten mixtures, but silver, which has many times the life of copper when tested under comparable conditions, does not show any appreciable initial bend in the wear curve (see Fig. 4, curve 2) owing, no doubt, to its relatively non-tarnishing properties. It seems that if a soft, friable film can be prevented from forming on the contacts their rate of wear will be reduced.

For materials such as copper and silver, the loss in weight of the contacts per given number of operations is substantially independent of the frequency of operation over a wide range from, say 20 to 2,000 operations per hour, but if the contacts are operating much faster than 2,000 times per hour the almost continuous arcing may raise their temperature to red heat with perhaps an accompanying sharp increase in the rate of wear. Some materials, such as some of the tungsten-silver and tungsten-copper mixtures, show rates of wear that are not independent of the frequency of operation, the loss in weight per operation often increasing as the frequency of operation is reduced.

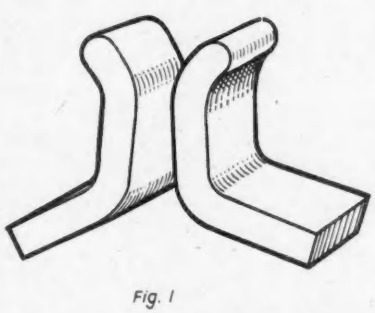


Fig. 1

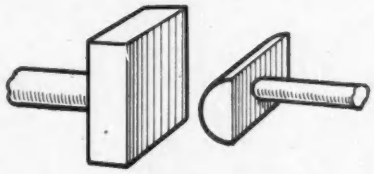


Fig. 2(a)

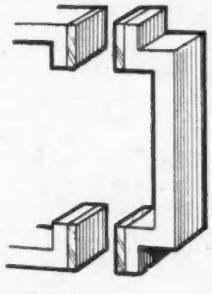


Fig. 2(b)

Fig. 1 & Figs. 2 (a) & (b). These sketches show diagramatically contacts with rolling (and sometimes sliding) motion (Fig. 1) and two types of butt contacts (Fig 2). That in Fig. 2 (a) has neither rolling nor sliding motion. Fig. 2 (b) shows a double-break silver-faced butt contact

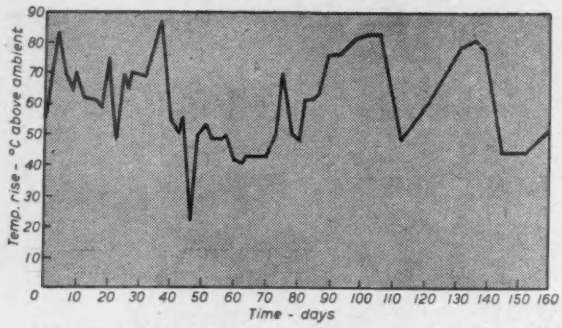


Fig. 3. Variation of contact temperature with time. The test recorded used copper contacts with a contact force of 12 oz carrying a current of 30 A a.c.

Effect of Power Factor on Wear

The power factor of the circuit has a marked effect on the rate of wear. If the power factor is approximately unity, the circuit may be opened with a relatively small contact separation, and the arc may extinguish at the end of the first half cycle. This happens with the micro-gap switch,[6] which will break successfully currents of 15 A at 250 V r.m.s. or 10 A at 400 V with a contact separation of a few thousandths of an inch. The rapid deionisation of the arc gap during the period around current zero ensures that the arc does not reignite, and since the arc is very short the arc voltage and the arc energy are small, the contact wear is practically negligible. Silver is generally used for the contacts, because of its good electrical and thermal conductivity and relatively non-tarnishing properties.

As the power factor of the circuit is reduced, the duty on the contacts becomes more onerous. If the power factor is approximately zero, practically the peak value of the circuit voltage occurs across the gap at the instant of current zero; this tends to cause reignition of the arc, and so a larger contact separation is required to interrupt a low power factor circuit. For given parameters there is a certain contact separation beyond which the arc will not reignite after the first current zero, but it is clear that this separation depends among other things on the point on the wave at which the contacts separate. Clearly the contacts must be able to cope with the worst condition.

In practice the arc does not usually extinguish at the end of the first half cycle, because the critical gap cannot usually be reached in so short a time, but if contact wear is to be kept low arcing must not be unduly prolonged. There is a practical limit to the contact velocity, but the arc can be rapidly elongated by devices such as a magnetic blowout. If the arc is suppressed so quickly that appreciable current chopping occurs, the inductive energy in the circuit is dissipated mainly in the arc instead of being largely returned to the circuit, and it may, therefore, be undesirable to have too great a velocity of contact separation.

It may be said that reducing the power factor increases the rate of contact wear; but the problem is a complicated one that has not yet been completely resolved.

Effect of Material on Wear

Much attention is now being given to various contact materials. As early as 1916, Steinmetz[7] showed that the tendency of an a.c. arc to reignite was related to the boiling point of the electrodes; the lower the boiling point the higher the reignition voltage.[8] If metals are tabulated in ascending order of their boiling points mercury and zinc are found near the bottom of the table. It is not difficult to see why these metals are not used for contacts. Mercury, being liquid, has obvious disadvantages. Zinc is a relatively poor conductor and gives a high contact resistance; also it has a low melting point, and, since a certain amount of arcing seems unavoidable, it possesses no advantages over the materials normally used. The idea of eliminating arcing by separating the contacts as the current passes through zero,[9, 10] and using a contact material with a high reignition voltage is an attractive one that has not yet been made practical.

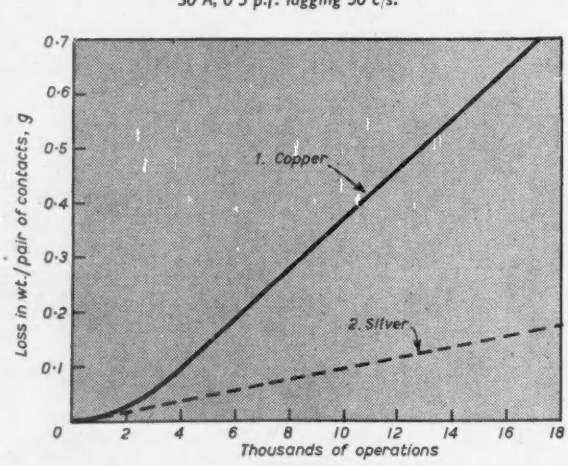
There is a fairly restricted choice of materials for heavy duty contacts. Expensive metals of the platinum group are obviously excluded. Silver is much used for small contactors and has several times the life of copper, with the added advantage of lower contact resistance, but it has not been much favoured in the past for large-current contacts. It has been said that the products of arcing are liable to condense on arc chutes and form a conducting layer, causing eventual flashover; and it would seem that silver is more prone to welding than copper when tested under similar conditions. There appear to be no large solid-silver contactor contacts in commercial use, although copper contacts with silver inserts are common.

Some years ago attention was given to the possibility of using tungsten as a contact material. It is very hard and wear resistant but oxidises readily and has a high contact resistance. The resistance was reduced by sintering the tungsten with silver or copper, and the material so produced was found to be very suitable for the contacts of circuit-breakers. It was found that it would withstand three successive short-circuit tests when copper would withstand only one. In view of this good performance some of these early contacts were tried for contactors. It was found that with repeated operation the material exfoliated badly and showed no advantage over copper. This shows that what is good for a circuit-breaker is not necessarily so for a contactor. The more recent tungsten-silver and tungsten-copper contacts of modified composition that are produced especially for contactors, and which now have a longer life than copper, show a reduced tendency to flake.

A material that is now widely used for contactor contacts is a sintered mixture of silver and nickel; its life is comparable, although not equal, to that of fine silver. It is harder, but the increase in hardness is obtained at the expense of conductivity. Other materials that are used are silver in combination with copper, cadmium-copper-silver alloys, and silver graphite.

It is abundantly clear that the life of a contact depends very much on the correct choice of material. The present

Fig. 4. Relation between loss in weight of contacts and number of operations. Contact force is 9 oz and the ratio closed period to total period is one third. Test conditions: single phase, 380 V, 30 A, 0·5 p.f. lagging 50 c/s.



aim seems to be to produce a material that has the conductivity of silver, non-tarnishing properties, and the hardness of tungsten. There is some doubt whether hardness is necessarily a desirable quality.

An interesting point, and one of great practical importance, is that the life of contactor contacts is greatly reduced if they are immersed in oil[11, 12, 17], and oil-immersed contactors are now seldom used for voltages below about 6 kV. The main cause of the increased wear is the formation of a localised hot spot on the contact, because movement of the arc root is impeded by the oil.

Other Factors Influencing Wear

The wear of contacts of a contactor operating a given number of times per hour may be varied simply by altering the ratio of the closed to the open period. The higher this ratio the greater is the contact wear. Although the effect of this preheating of the contacts on the wear is not great, it can cause a variation of 30% and should, therefore, be rigidly controlled when comparing the wear resisting properties of different materials.

It would seem that the contact force may affect the rate of wear, because a greater force means a lower contact resistance, less pre-heating, and less wear. There is little experimental evidence available in support of this statement but a few tests made by the E.R.A. indicate that it is probably true.

The contact wear for a given current and power factor increases with the voltage and, as the example in Fig. 6 shows, appears to be roughly proportional to its square; this relation, however, applies only over a limited range, since if the voltage is increased too much arcing persists.

The wear also increases with the current but the relation is not a simple one. It is known that the potential drop along an arc approaches a constant value with large currents, and the rate of dissipation of energy in the arc is then roughly proportional to the current. The wear does not, however, necessarily increase linearly with the current because the increased energy may prolong arcing; and it would seem from tests made here and on the Continent that the wear can be roughly proportional to almost the square of the current[13] over a limited range of current.

The relation may depend on the design of the contactor. This is shown by the curves in Fig. 5, which relate to two commercial contactors of 150 A rating. One exhibited a rate of contact wear almost proportional to the current (curve 2), but the wear curve of the other (curve 1) is of a different form. Up to about 90 A the wear could be regarded as roughly proportional to almost the square of the current, but beyond this current the rate of wear increases more slowly. This simple illustration serves to emphasise the danger of drawing general conclusions from the results of tests on one model, especially when the true relation may be masked by a number of uncontrolled variables.

As a matter of interest, the E.R.A. have made comparative full load wear tests on two commercial 400 V contactors rated at 30 A and 150 A respectively, and the loss in weight of the contacts per thousand operations was found to be roughly the same. This does not invalidate what has already been said because the contactors were of widely differing designs (the contact force, for example, of the 150 A contactor was more than ten times that of the 30 A model), but it serves to emphasise that the wear cannot be estimated solely from the current without taking other factors into consideration.

Contact Wear in D.C. Circuits

There is a significant difference between the rates of wear in a.c. and d.c. circuits. With alternating current the periodic passage of the current through zero assists arc

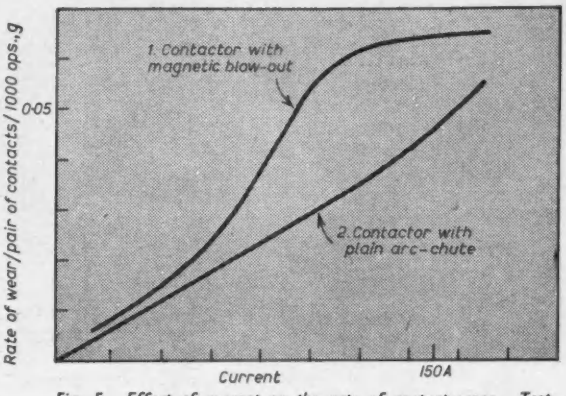


Fig. 5. Effect of current on the rate of contact wear. Test condition 260 V 1 ph 0·5 p.f. 50 c/s.

extinction, and since this does not occur with direct current the d.c. circuit must be broken by making the arc unstable. With a short arc gap the minimum stable arc current may be less than 1 A in a d.c. circuit, and the micro-gap switch that will break 15 A at 250 V alternating current will deal with only 0·1 A at 250 V direct current.

The way in which arc extinction is brought about in a d.c. circuit is illustrated in Fig. 7. Curve 1 represents, for an arc gap of given length, the familiar arc voltamp static characteristic, the slope of which is negative. If A represents the circuit voltage and the tangent (curve 2) is drawn from A to curve 1, it touches this at point P which represents the minimum stable arc current. The slope of curve 2 represents numerically the circuit resistance and, since this is fixed according to the rating of the contactor, the contact separation must be large enough for curve 1 to lie well above curve 2, and then arcing cannot persist. When the contacts just separate the arc voltamp characteristic is as shown in curve 3 and as the arc elongates the current decreases to the minimum stable value, which may be several amps, and then the arc extinguishes. Since a sudden reduction of current may cause an induced voltage, the contact separation must be increased in inductive circuits.

It is evident that the greater the velocity of contact separation the smaller is the arc energy. There must be some relation between arc energy and contact wear, but information in published literature is relatively meagre.

With regard to contact materials, practically the same materials are used for direct as for alternating current. The requirements of low contact resistance and freedom from tarnishing are common to contacts in both circuits. It is also reasonable to suppose that a material that resists arcing in an a.c. circuit will exhibit the same property with direct current, the basic difference being that with direct current there is no periodic passage of the current through zero, with consequent deionisation of the arc gap, and the rate of wear may depend on the polarity.[14]

Much has been written about erosion of contacts in d.c. circuits, but the investigations have usually been confined to relatively small voltages and currents. It has been found that not all the volatilised metal is lost, because some condenses on the contact. Holm[14] states that the quantity of metal evaporated is proportional to the number of coulombs in the arc, and in a particular case with silver contacts and currents of a few amps at voltages up to 220 V he found that about half the evaporated metal was lost. The amount lost is found to depend on the physical properties of the material. Such results are of great interest, but experimental confirmation is lacking with the relatively large currents and strong magnetic fields used in practice.

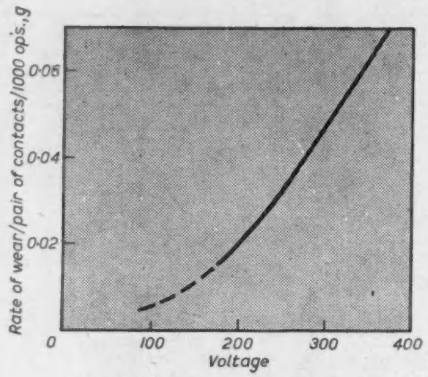


Fig. 6. Relation between voltage and rate of wear. Ratio closed/total period is one third. Test conditions: 30 A, 0·5 p.f. 50 c/s, 8 ops/min.

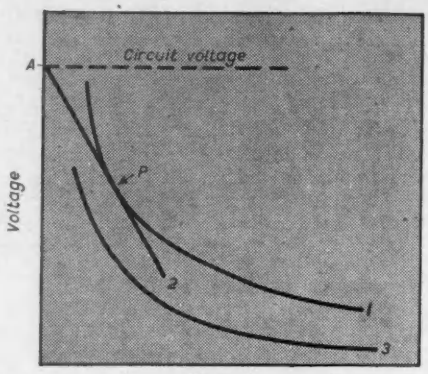


Fig. 7. Circuit and arc volt-ampere characteristics, illustrating way in which arc extinction is brought about in a d.c. circuit

Most modern contactors close with a relatively high contact velocity and, since the contacts are elastic, there is usually a certain amount of contact bounce.[1] This can cause appreciable contact wear, and it has even been said that the wear at make can exceed that at break,[15] especially in certain applications such as the control of motors, when the starting current may be several times the full-load current. Since the arc gap is very short it might be thought that most of the volatilised metal would condense on the contacts, but this is not always so. Some contactors are fitted with a powerful magnetic blowout and the arc at make is often considerably elongated, sometimes appearing as a vivid flash, and almost the whole of the volatilised metal may be lost. Suggestions have been made for overcoming this difficulty, such as short-circuiting the blowout coil until it is required, but little seems to have been done commercially in this respect.

The elimination of arcing at make is highly desirable, and the reduction of arcing at break (and, if possible, its elimination) is equally important, since the bulk of the contact wear results from the energy liberated in the arc. A well designed arc chute[16] that reduces the arc energy, rather than one that merely confines the arc and prevents flashover, should thus reduce the contact wear.

Magnetic blowout coils are now widely used, both on d.c. contactors and on a.c. contactors of the larger current ratings, but there is not yet universal agreement on the strength of the magnetic field.[1, 11, 12] The blowout may be incorporated with an arc splitter[17] and, in general, the aim is to give the contactor a certain amount of breaking capacity, since it may be required to break ten times its full-load rating. What is good from the standpoint of breaking the circuit may not be so in regard to contact wear; moreover a.c. and d.c. contactors require different treatment, because circuit interruption is usually easier with alternating current, and does not always require so great an elongation of the arc, especially since interruption tends to occur naturally at a current zero.

It has already been mentioned that the contact wear is influenced by the contact force, and also by the velocity of contact separation. With most commercial contactors an increase in one causes an increase in the other, and this may be no disadvantage; but further research on this point is required. The contact force may even be determined in practice by factors not associated with contact wear since, if the contactor is closed on a fault, the electromagnetic forces may be sufficient to open the contacts momentarily, and this may cause them to weld.

Attempts have been made to reduce contact wear by using arc suppressors.[10] In small-current d.c. circuits they are beneficial, and will extinguish an arc that would otherwise persist, but with large currents the capacitor becomes impracticably large. Other means of arc suppression, such as resistance switching, are not used to any extent.

Conclusion

It might be inferred from this brief review that comparatively little is known about heavy duty contacts. Although there are large numbers of contactors in use and giving satisfactory service, they have evolved largely as the result of practical experience and testing; and the fact that the fundamental theory underlying contact wear is not yet fully established is no reflection on the manufacturer. Normal development work has its proper place in industry and will continue, but the present need is for more fundamental work on which sound design may be based, and especially to extend earlier work to much greater currents and voltages. Industry is well aware of this need and the E.R.A. have now built and partially equipped a laboratory especially for this work.

The author is indebted to the Director of the Electrical Research Association for permission to publish this paper.

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From an engineer's notebook

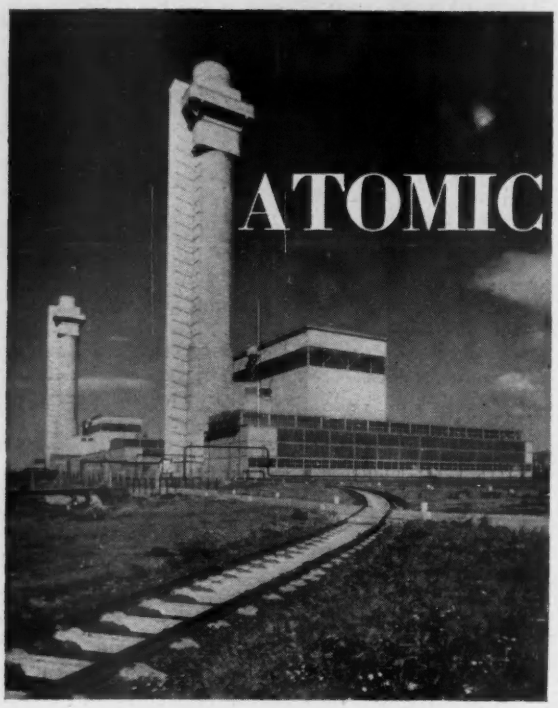
A CHANCE meeting of a medical friend in my immediate post-student days led, I recall, to my being smuggled into a medical exhibition which was barred to all but the select. My friend's macabre delight in his explanations to me has no place in these notes, nor their effect on my stomach, but I did gain a healthy respect for the craftsmen who manufacture the fearsome looking instruments. Particularly, I remember those long tubes with a small lamp at one end and an intricate lens system which enable a doctor to explore our innermost secrets. Fortunately, the ensuing years have brought no closer acquaintanceship with these devices, and no doubt improvements in their design have since been made. What promises to be a major step forward, however, appears likely from the development of methods of what may be termed "piping" images. This is based on the ability of a glass or plastic fibre to conduct light by reason of the internal reflections of the walls. By the use, therefore, of bundles of fibres each of two to three thousandths of an inch in diameter and formed into a conducting channel, images can be transmitted from end to end. The idea appears to have been suggested by Baird, but certain insects seem to have discovered the principle even earlier. The idea certainly has all the appeal of simplicity and should provide a higher degree of light transmission than is possible through the many air-glass surfaces of a complex lens system, while it permits the viewing of detail down to 0·005 in. Improvement in technique of producing small fibres should lead to greater resolving power, and permit applications in many spheres other than those of examining our stomachs and the like.

* * *

ONE is sure to be topical in writing about rain in this country, while, scientifically speaking, there does seem to be a deal of interest at the present time in the study of those drops which have spoiled many an afternoon's picnic. An important advance in the means of determining the frequency distribution of drop diameter appears to have been made by the development of a form of photo-electric spectrometer. Hitherto work on rain forms has been limited by such crude methods as allowing the drops to fall on flour and measuring the pellets thus formed. The new apparatus is simple enough. The raindrops are allowed to fall through the test area which is subjected to a parallel beam of light. In consequence the drops scatter the light into the cathode of a photo multiplier cell and the resulting readings analysed by means of calibration tables previously calculated from tests with drops of known size. Raindrops, however, besides having the all too familiar physical characteristics of size and quantity appear to carry electrical charges as well. According to a recently reported investigation, a free charge of 0·022 e.s.u. was the average for positively charged drops, while a higher average value of 0·031 e.s.u. was found for negatively charged particles. This out-of-balance between charges was to some extent compensated for by the greater number of positively charged drops, the ratio reported being 0·88. The existence of electric charges on raindrops has, of course, long been known, but I do not recall earlier quantitative experiments. I feel they will have to be repeated over a much wider geographical area before any satisfactory conclusions can be reached. In the meantime, however, what may prove to be a disturbing factor has appeared on the scene. A report from Arkansas records that rain water samples collected last summer were found to be radioactive and contained sources of beta radiation. From a study of the rates of decay it was concluded that the sources were the product of nuclear fission rather than naturally occurring radioactivity, and were matched in character with that of the radioactivity in the prevailing air mass. The question that immediately jumps to mind is the nature of the geographical distribution of this radioactivity. With the vastly expanding activity in nuclear fission, it is a question that will have to be answered in the not far distant future. And if too many atom bombs are exploded we shall no longer have electrically charged raindrops, but radioactive ones.

* * *

THOSE of us who live in industrial cities know that the general problem of air pollution remains very much with us. Within buildings, however, where the task is of manageable proportions, it has become a routine engineering task to provide relatively clean air in reasonable quantities at specified temperatures and humidities, but even these excellent schemes are unable to deal with the smog which begrimes our winter. Infection, too, is not eliminated by air-conditioning plant and, of the several approaches made to air sterilisation, ozonisation and irradiation have both reached a stage of commercial development. A further method, which is now receiving attention, is aimed at removing all those unpleasant things in air which we are compelled to tolerate in an imperfect world. Viruses, smoke, pollens are said to be removed by ionisation with unipolar ions derived from a radioactive source in preference to a thermionic one. The choice of a suitable alpha-emitting isotope has presented some difficulty because of the usually attendant beta and gamma radiation. In experimental work, therefore, polonium has been selected since it emits only alpha particles, but its half-life is no more than 140 days. It is prepared as a foil with a silver backing to limit the direction of emission, and is placed in the stream of air passing through the ventilating plant. To limit the polarity of the emitted ions, an electrode is placed in front of the emitting surface and by applying a voltage the ions of unwanted polarity are attracted out of the air stream. An arrangement of this sort can give a satisfactory degree of ionisation with air speeds up to 450 ft/min. Much work remains to be done in basic design and in the choice of a suitable isotope of longer half-life, before a stage of commercial development is reached. By that time we may find isotopes in use for the purification of boiler flue gases.—*E. R. G.*



ENERGY in Great Britain

Details of the three major processing factories engaged in fissionable material production for research, defence purposes and industrial usage

AT long last, within the limits of security, the veil has been lifted on the atomic energy organisation which has been built up since the war in this country, and the story has been revealed in "Britain's Atomic Factories" published by H.M.S.O. price 6s. Headquarters of the production organisation is located at Risley, in Lancashire, whence are controlled the design, construction and operation of the three large factories which form the main production units. These factories were built under most difficult conditions. Apart from the shortage of materials and equipment, which was most acute in the initial stages, the nature of the tasks which they had to undertake required exceptional design restrictions, many of a nature which had never been tackled before. In addition much of the plant had to be built without comprehensive knowledge of the actual processes which it was destined to carry out.

The Factories

The first job of the Risley team was to design and build a factory capable of producing many tons of uranium per annum from the crude ore. One of the chemical defence plants located at Springfields was selected for this purpose. The process by which uranium is extracted is extremely complex chemically, involving the crushing of the ore to a fine powder, several chemical reactions with the powder dissolved in acids to precipitate impurity and then extraction of uranium oxide. The oxide itself, though pure enough by most standards, is yet sufficiently contaminated with neutron-absorbing substances to preclude its direct conversion to metallic uranium and use in atomic piles. Consequently the oxide is again dissolved in acid and by selective solution in ether, purified uranyl nitrate derived. The uranium is then precipitated as ammonium diuranate, and converted to the metal in two stages. The diuranate is converted to pure uranium tetrafluoride by heating in electric furnaces, reducing it, and then reacting with hydrogen fluoride gas, and then reduced to metal by mixing the tetrafluoride with calcium chips and firing the mixture in a furnace. The final pure product after test is cast, machined accurately, and enclosed in aluminium cans.

At Windscale, plutonium is produced in two large air-cooled production piles. This factory is conspicuous by its two tall chimneys, each over 415 ft high, which take away the temporarily radio-active cooling air, and other short-life by-products. Enormous quantities of air are required for cooling and this is provided by several motor-driven specially designed blowers. The use of air cooling was decided upon, as the air-cooled pile is inherently stable and comparatively little damage would be done even in the event of simultaneous failure of air cooling and of the control system.

After irradiation, the plutonium is extracted from the uranium by a solvent extraction process which is carried out in a completely isolated plant. The radio-activity of the irradiated uranium is so high that every operation and control must be carried out from behind thick walls of concrete. Moreover the plant itself becomes intensely radioactive and there is consequently no possibility of personnel getting near it to correct faults or carry out maintenance. It involves no valves and no pumps, only columns, tanks and miles of connecting pipes all completely shut away in a concrete box. Remote control and instrumentation are of course essential.

From this plant come four liquids: an impure solution of plutonium, a large quantity of impure solution of uranium, a large amount of dirty solvent, and a great deal of intensely radio-active fission products. The plutonium solution is turned into plutonium metal, the uranium solution goes back to Springfields after purification for reprocessing, the solvent is cleaned and used again, and the fission products separated, the most highly radio-active

fractions being led into storage tanks, constructed to be virtually indestructible, where it will remain indefinitely.

At Capenhurst, separation of uranium 235 from the more abundant 238 is carried out by a gas diffusion process. This uses hexafluoride from the Springfields factory. The output actually consists of uranium highly enriched with the uranium 235 isotope.

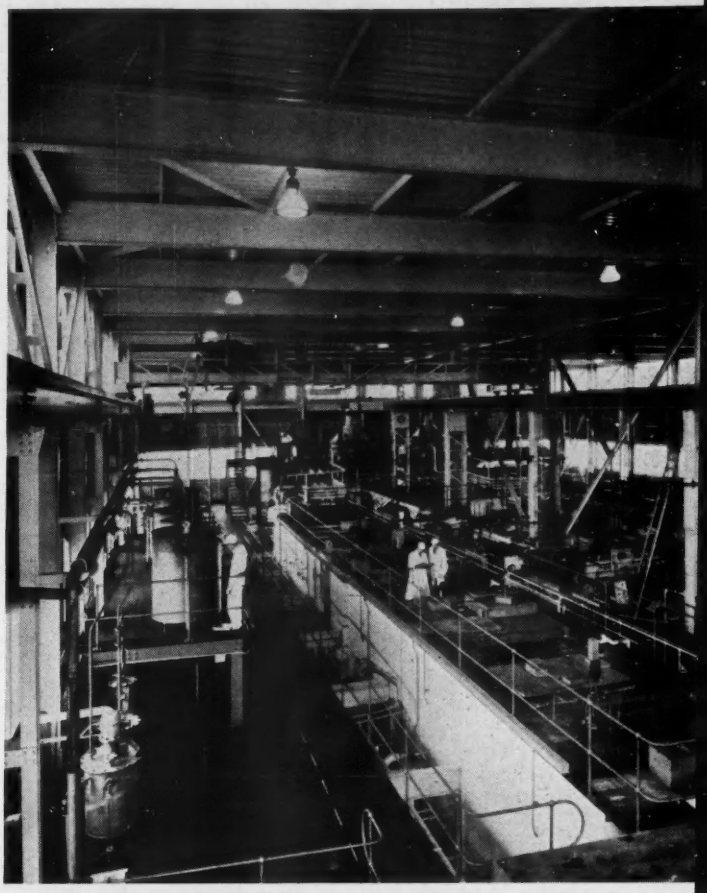
Power Prospects

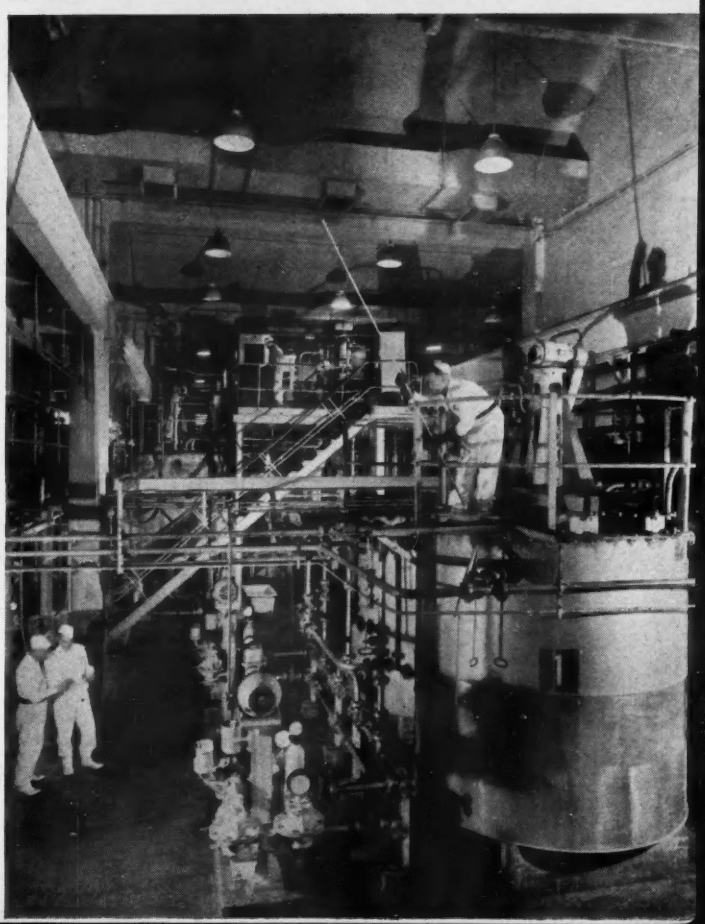
After discussing health hazards and the administration and organisation of the factories, the report considers the future of useful power from nuclear fission. This is very much the concern of Risley, and presents the outstanding challenge of our time to engineers. In the Windscale piles and similar reactors, this heat is an unwanted byproduct in the production of plutonium. Factors involved include the choice of the type of reactor. Either a slow or a fast reactor could be used, the latter having the advantage that it can also act as a breeder. To run a breeder, however, it is necessary to build up stocks of either plutonium 239 or uranium 233, and these can only be obtained by using the primary 235 to convert 238 into plutonium, or thorium 232 into uranium 233. This would need to be done in a convertor such as the Windscale pile. However, for certain purposes it might be desirable to build reactors solely for power production and these might be slow fission reactors using natural uranium slightly enriched in the 235 isotope or fast reactors using uranium 235 or plutonium or uranium 233 but with no provision for breeding. They might also be of an entirely different type in which use is made of fission at neutron energies.

There are thus three main kinds of reactor likely to be necessary in a power programme—power convertors, power breeders and simple power producers. All these generate power in the form of heat and the major problem is how to remove this heat and convert it into electrical or mechanical energy. Various heat transfer systems are being studied at Harwell, one of which is the use of molten metals such as an alloy of sodium and potassium. Gas under pressure is a further possibility; but whatever coolant is used it is improbable that it could be utilised directly to drive electrical generators, but would be passed through a heat exchanger to produce steam.

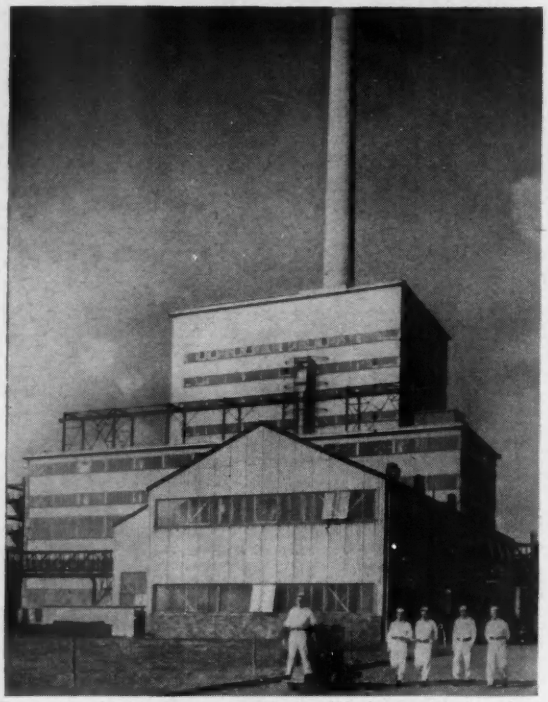
Economics

A further question concerns the chemical plant required to extract fuel from either convertor or breeder reactors. If this extraction could be simplified or accelerated a large reduction in operating costs would result. This indeed is one of the principal factors affecting the economics of an atomic power programme. There are a host of other problems to be solved—the design of fast reactor cores, fuel elements, behaviour of structural materials under conditions of high temperature and intensive irradiation, the chemistry of core reactors, and so on. Extensive studies at Harwell and Risley have, however, convinced scientists that nuclear energy should be able to make a substantial contribution to electricity supply at a cost comparable with the cost of coal-generated electricity. In fact if certain assumptions turn out to be valid, it might ultimately be possible to replace coal completely by nuclear generation in the future. A more immediate objective, one that might possibly be realised in twenty years, would be to set up a reactor system which would generate enough





Top: Inside the uranium purification plant at the Windscale factory. In this plant the impure uranium solution from the primary separation plant is purified. The lower photo shows the crude uranium oxide plant at the Springfield factory. It is here that the crushed ore is ground to powder and dissolved in acids



The completed primary separation plant at Windscale with the solvent recovery plant and workshop in the foreground

electricity to produce a saving of 20 million tons of coal per year—the amount by which estimated production will fall short of estimated consumption during the next fifteen to twenty years. A possible way to do this would be to build a number of power convertor reactors using natural or slightly enriched uranium. The construction of these units would be spread over the twenty-year period, during which a steadily increasing amount of coal would be saved and at the same time the stock of plutonium would be built up. By the end of the twenty-year period efficient power breeders should have been developed to the point when they could be built in numbers large enough to achieve the ultimate goal—the generation of all the electrical requirements of the country. These units would be fuelled initially on the plutonium produced by the power convertors.

It should be emphasised that this is not a programme but only a suggestion based on a number of assumptions which have yet to be proved experimentally. Nevertheless it is believed the scheme is technically feasible and that it might be possible to carry through a project on the lines suggested. It is also believed that the idea is on a sound economic basis as far as costs of production are concerned.

Present Work

The pressure-gas-cooled reactor is an attractive proposition and for some time Harwell scientists have been studying the feasibility of developing the design in a form that would be suitable for producing power as well as plutonium. These studies were made in collaboration with industry and with the B.E.A. and it has been decided to build a power station on these lines at Calder Hall, alongside Windscale. The coolant will be carbon dioxide and boilers will be placed round the reactor. It is hoped that work on this project will resolve the question of the length of time that uranium may be left in the pile before it is necessary to remove it for re-processing.

The second stage in the Risley scheme is the design and construction of a prototype fast reactor for power production and breeding. There are even more uncertainties in this project than in the construction of "Pippa," the gas-cooled power convertor. One of the more important tools in this work is the sero-energy fast reactor being built at Harwell, which will provide a means of studying control systems and the behaviour of fuel elements in a fast fission pile.

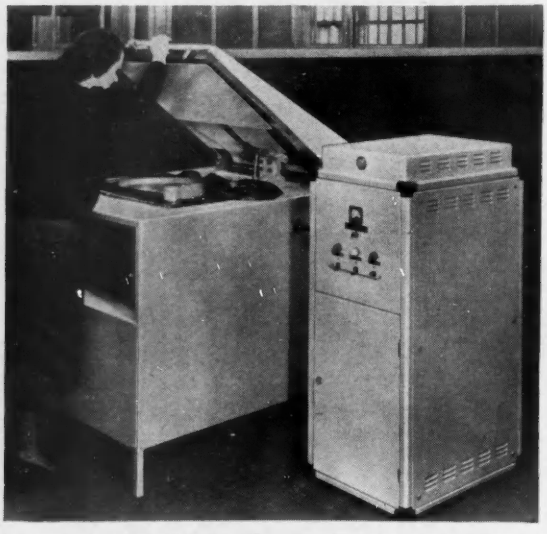
Dielectric Welding of Plastics

THE ease and rapidity with which plastic materials can be welded, has commended itself to manufacturers of raincoats and similar products who are enthusiastically adopting this technique which overcomes the inherent weakness of joins made by stitching.

Many different types of welds can be made ranging from "spotting" to long continuous seams. In the former case, the weld is made by bringing an electrode down into contact with the material and then applying high-frequency power for the requisite time.

Shown in the illustration is the Metrovick plastic welder type 311 W, which is a one kW machine designed for the seam welding of plastic materials in a single operation. It is a completely new design and will cater for a greater variety of applications than was possible with previous machines. Up to 2 ft of straight seam can be welded in about three seconds, and electrodes can be supplied for any contours such as those needed for the welding of pockets. The high-frequency generator is at present a separate unit, but a self-contained model will shortly be available.

The equipment is completely automatic in operation, the welding cycle being pre-set by process timer. Electrodes are self-aligning and full protection is provided against misuse. The welding times or voltage cannot be altered except by operation of a removable key.



The Metrovick type 311 W welder working on pockets for plastic mackintoshes

QUEENSLAND PROGRESS

SATISFACTORY progress is recorded in the Sixteenth Annual Report of the State Electricity Commission of Queensland, where new central stations for three Regional Board areas have been commissioned and ample supplies are now available in these areas for all purposes. These commissionings have already resulted in considerable tariff reductions, particularly in rural areas.

In south-eastern Queensland, two "packaged" 10 MW units have been put to work in Brisbane and construction is proceeding on two major power stations in the same city. The first plant in Bulimba "B" will be in operation in the near future. In the far north of the State, the Cairns Regional Electricity Board has recently installed or is scheduling for early installation, additional diesel generating plant of 4,950 kW to meet demands of the region until the Tully Falls hydro-electric project is commissioned. Good progress is being made on the latter and it is hoped that the scheme will be in operation by the end of 1955.

Earth Return System

Of particular interest is the section in the report dealing with the experimental earth return distribution systems installed by the Cairns Regional Electricity Board. This method was designed to reduce the cost of extending electricity supply into areas where three-phase or the standard single-phase would be too costly in view of the widely scattered population and low load intensity.

The two trial installations are at Atherton and Malanda, and each has its own isolating transformer and supplies 20 and 12 farms respectively. Each installation can, however, be expanded to cover 30 to 40 farms from the existing isolating transformer.

The single wire voltage is 12·7 kV, and the conductors are generally 3-12 galvanised, 90-ton quality steel strand with average spans of 1,020 ft. The largest span is 1,940 ft. The single-phase isolating transformers are 50 kVA 22,000/415/240 V fully insulated and the single-phase local distribution transformers are 5 or 10 kVA 12,700/480/240 V with graded h.v. insulation.

Financial Results

The estimated cost of works on hand, scheduled for commencement during the current financial year by local authorities now totals £53,317,000 and of this some £24m has already been expended during the past financial year. Public loans and private loans amounted to £3,905,350. In the aggregate, State Electricity Commission loans have been almost fully subscribed by the small public investor. For the four boards, Wide Bay-Burnett, Capricornia, Townsville, and Cairns, receipts in the 1953-54 Budgets total £3,428,981 while expenditure for the same period is £3,433,556.

Grants under the Government's subsidy scheme for regional electrification and electrical development generally have continued to be of substantial value to electricity authorities during the year.

Battery-Operated Cranes

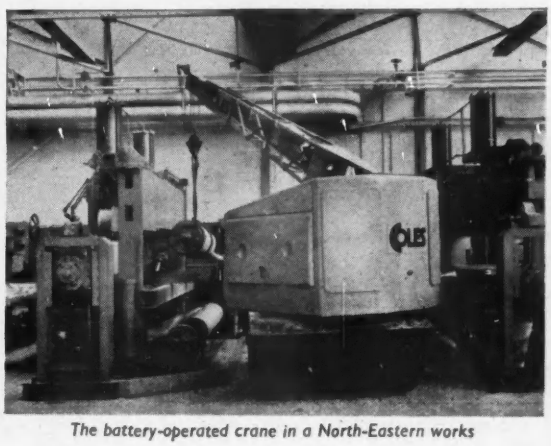
AN unusual handling method has been adopted in a recently-opened factory in the north-east, where two battery-operated self-propelled 1-ton capacity mobile cranes, manufactured by Steels Engineering Products of Sunderland, have been put to work. The reason for the introduction of this form of handling lies in the danger from fire in a factory where paper, fabric, resins, spirits and other highly inflammable materials used in the fabrication of heavy duty bushings and other electrical equipment, are being handled. The absence of noise and fumes was also a major consideration.

Each crane has four motions—hoisting, derricking, slueing and travelling—each motion being controlled by electric motors. With the exception of the travel motor which is mounted on the four-wheel chassis, all the motors, together with the battery and the control gear, are housed in the fully enclosed revolving superstructure.

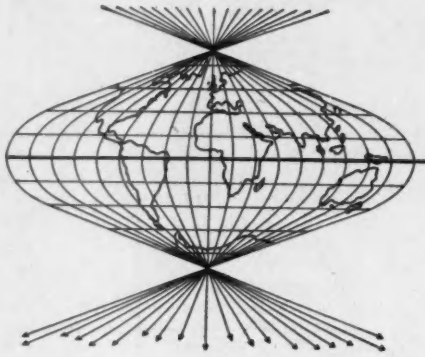
For hoisting, a 1¼ h.p. vertically mounted motor is used, driving through a worm reduction gear. A grooved steel hoist barrel on which a 1 in. plough-steel rope is coiled in one lap is splined to the self-aligning slow-speed shaft and a two-fall rope reeving lay-out is employed. The motor, controlled by an electro-magnetic brake and self resetting limit switches hoists the maximum load of one ton at a speed of 35 ft per minute.

A further 1¼ h.p. motor, also fitted with an electro-magnetic brake, slues the superstructure in a complete circle in either direction by driving a vertical worm reduction gear through a propeller shaft and a special slipping clutch which prevents the transmission of shocks on starting and stopping. The 80-V operated 6 h.p. travel motor is connected by propeller shaft to the differential, and gives 4 to 5 m.p.h. unloaded and 3 to 4 m.p.h. loaded.

Control is extremely simple. The battery, consisting of 40 Exide-Ironclad cells with a capacity of 192 Ah, is arranged in two 40-V sections. These two halves are connected in parallel for hoist, derrick and slue motors and for first and second travel speed conditions, but for travel positions 3 and 4, they are connected in series to provide 800 V. The travel controller automatically disconnects the supply to these motors when third or fourth travel speeds are in use. With an overall length in travelling order of 19 ft 6 in., and a track of 4 ft 6 in., each crane has a clearance height of 8 ft 9 in. with the jib horizontal, and a chassis turning circle of 20 ft. Approximate unladen weight is 6 tons.



The battery-operated crane in a North-Eastern works



OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

CANADA

Hydro Station Restored

The Whatshan hydro-electric station of the British Columbia Power Commission has been put back into service. It will be recalled that the station was put out of action in the latter part of August when mudslides engulfed the switchyard and damaged the power house structure. Only one of the generating units is in service, however, the other set which was damaged in the incident, being still under repair.

Hydro Power Capacity

Hydro-electric generating capacity brought into operation during 1953 was somewhat lower than of recent years. New capacity in 1953 totalled 638,012 h.p., bringing the total capacity of all water-power plants in Canada to 14,921,459 h.p. Plants and extensions under construction for operation in 1954 amount to 1½ million h.p. Total power consumption in 1953 was about 7% above 1952.

Action Against Commission

A big legal action involving the Hydro-Electric Power Commission of Ontario is brewing in that Province, we hear. Four pulp and paper companies and a log transport firm have issued a writ for $1 million damages against the Commission for alleged interference with the normal flow of the Ottawa River. The Commission has three large dams and power stations on that river. The companies claim that by forming power pools behind the dams and through reduced flows below the dams, the Commission has interfered with an absolute right enjoyed by the companies to have normal flow carry their logs downstream. Instead of using the river's power to move the logs in the old free-running drives, the companies have been forced to hire or buy tugs, build docks and harbours and provide other semi-permanent installations. The companies concede that chutes built for carrying logs around the dams are as good as any devised by engineering science. They are claiming $600,000 in costs and $400,000 for general damages in increased costs of moving the logs. But the Commission has replied with a $190,000 countersuit, representing the value of dock installations which it built for the five companies for use by their tugs.

U.S.A.

Another Contract

Although a British and an Austrian firm submitted lower tenders, the Westinghouse Electric Corporation, of Pittsburgh, has been given a contract for a transformer for the Bonneville power project in Oregon. The Westinghouse tender price was $771,346, compared with $634,890 of the English Electric Co., and $586,000 of the American Elin Corporation — an Austrian concern. Even after application of the 25% "Buy American" differential, the quotation of the Elin Corporation was still the lowest, but the specifications required that the tenderer should have had considerable experience in the design, construction, testing and actual operation of such transformers, an official has stated.

NORWAY

Norway's Programme

Further to our review of Norway's power development programme in our 31 Dec. issue, we now have news that a total of 320 MW of new hydro-electric generating capacity was completed in 1953 in that country. Under present plans a total of 1,600 MW of hydro-electric generating capacity will be added in the five year period ending 1957. The Norwegian Electricity and Water Board is now considering the development of water power at Tokke, in East Norway. Here a 400 MW plant is envisaged, which would be the largest single power plant in Norway.

EUROPE

Copper for Spain

To help speed up the construction of a new 220 kV transmission line linking Madrid with north-west Spain, that country is to receive $2 million worth of copper and aluminium as the first United States allocation of the $85 million grant to Spain under the recent defence-and-aid agreements. This new transmission line will enable more power to be despatched from Galicia than can be sent via the existing 130 kV line. The new line has been about half completed for some months, but further work has been held up awaiting supplies of copper and aluminium. For some time now, Madrid and certain other cities have suffered from power cuts, largely due to the lack of rainfall during the past eighteen months. For Spain depends to a large extent on hydro-electric generation. Of the 9,700 million units generated in 1952 over 80% were from hydro-electric plants.

Loan for Austria

The World Bank has granted Austria a 350 millions schilling loan for the development of the Kreuzeck hydro-electric power plant in Carinthia. However, the loan was granted out of the Italian capital deposit in the World Bank, in lire, and the Italian authorities are pressing Austria to accept the major part of the loan in the form of capital equipment for the power plant, it is now reported. But now that Austria is producing a good quantity of such equipment the Government is unwilling to accept the Italian proposal, we understand. It seems likely that the World Bank will be asked to re-examine the question of the loan with a view to granting credits in other currencies than lire.

SOUTH AFRICA

New Station for Cape Town ?

For more than a year the Cape Town City Council has been considering the best policy to adopt to meet the situation when the "pooling" arrangement comes to an end in May 1957 as the Electricity Supply Commission of South Africa has already intimated that it was not prepared to renew the agreement. It has now been decided that the Council should retain its independence in the generation and distribution of electricity, and in order to implement this it has agreed in principle to the building of a further power station. The date of erection, however, is to be determined when circumstances are most favourable and the city electrical engineer, Mr. C. G. Downie,

is to investigate and report at the earliest opportunity on the most suitable sites. In the meantime negotiations are to be conducted with Escom to ensure the shortfall in supply generated by the Council being obtained from the Commission, and the Electricity Committee of the Council has been given authority to negotiate and conclude an agreement on the terms on which the Commission will supply the Council with current after the termination of the "pooling" agreement.

INDIA

German Order from India

Further evidence of the strong efforts being made by German firms to gain a foothold in India, is the news that the A.E.G. Co. of West Berlin has been given the order for the supply and manufacture of one 62·5 MW steam turbo generator for the new Trombay power station of Tata's. Steaming conditions are 12,500 lb/s.i., and 950° F., we understand. It will be recalled that much controversy raged over the efforts of the Tata Power Co. to convince the Government of Bombay that two such units should be installed together, but the Government refused to agree to that proposal, maintaining that the Koyna hydro-electric scheme, now under construction, should be able to meet the increasing demand in time.

O.H. Wires in New Delhi

Overhead electric wires are being utilised increasingly in New Delhi localities, and some of the inhabitants are showing concern at the trend. The regulation insisting on underground cables was relaxed during the war and the high cost of laying cables below ground has prevented its strict re-enforcement, it is reported. Most of the new colonies in the area have overhead lines, apart from the more exclusive districts such as Sunder Nagar. While it has been attempted to limit o.h. wiring to the older parts of New Delhi to service lanes and lesser-frequented areas, they have spread to the main roads in a number of instances. Some temporary extensions of power lines have also a tendency to become permanent, it is stated. No target date has yet been fixed by which time the power lines are to be placed underground, and locally it is feared that unless such a step is quickly taken many of the more fashionable parts of the capital will soon have o.h. lines.

Support for Manufacturers

India must become self-sufficient in the supply of raw materials for electrical industries declared Mr. K. C. Reddy, Central Minister for Production, when inaugurating the sixth annual meeting of the Indian Electrical Manufacturers' Association, in New Delhi last month. It was also necessary to regulate imports so as not to affect adversely the supply position within the country and at the same time not place other producing units at a disadvantage, he said. In his presidential address, Mr. T. S. Sitapati welcomed the recently proposed step of the Government of India to start an Industrial Development Corporation comprising Government representatives, engineers, scientists and industrialists. It was claimed, he said, that the proposed Corporation would quicken industrialisation and revolutionise the country's economic activity. In order to rapidly expand the Indian electrical manufacturing industry it would be a great assistance to all interests if a Development Council was constituted, he added. Such a council was essential to co-ordinate all national efforts in the electrical field, and he hoped the Government would lose no time in constituting such a Development Council.

AUSTRALIA

330 kV Lines for Australia

Australia is to have a 330 kV transmission line. This will be used to transmit power from the Snowy Mountains hydro-electric scheme to the New South Wales inter-connected system supplying Sydney and the surrounding area. That line will be about 270 miles in length. It is planned eventually to erect a similar voltage line running in the opposite direction to Melbourne. These 330 kV lines will be the highest voltage transmission lines in Australia—at the moment the highest in use is 132 kV, although a 220 kV power line is now under construction in Victoria. We understand that much of the preliminary work relating to these new power lines has been done, but tenders for the necessary equipment have not yet been called.

Tungatinah's Output

Recent heavy rains in Tasmania have brought about a considerable improvement in the hydro-electric catchment areas, and enabled the new Tungatinah power station to be worked to capacity. This news was given recently by Mr Knight, Hydro Electric Commissioner, who stated that in one week 6 in. of rain had fallen at the northern end of Great Lake. The three 35,000 h.p. machines at Tungatinah have thus been maintaining their full output. Work is in progress on a fourth machine at the station, and this set should be in commission towards the middle of this year.

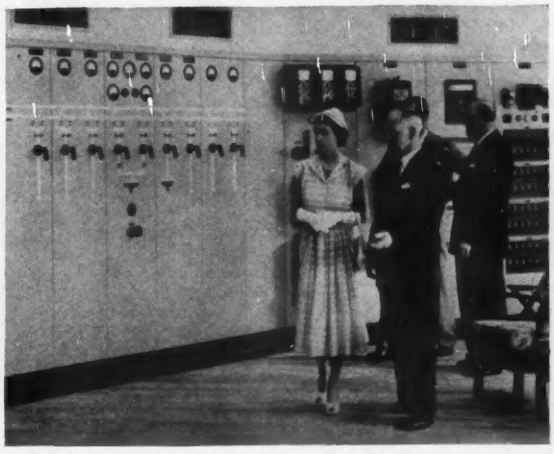
Electrification in Queensland

The largest rural electricity project of its kind undertaken in Queensland has reached an advanced stage in the Monto district. The Capricornia Regional Electricity Board is spending £314,300 in the Monto shire in the current financial year on electricity for town and farm lighting and power. It is expected that the area will get its supply of electricity from Rockhampton power station by the end of this month. The Regional Electricity Board is erecting a 66 kV line from Rockhampton through Beecher and the Boyne Valley. Cost of this line is estimated at £87,000. Another line goes via Dawson Valley and Thangool. This has cost about £103,000. The existing power house at Monto is being converted into a substation. With the coming of this supply, tariff rates in Monto shire are being reduced from a 70% surcharge to 10%.

NEW ZEALAND

Plant for Atiamuri

An order has been placed with A.S.E.A., of Sweden, for three 21,000 kW generators for the new Atiamuri hydro-electric station by the New Zealand State Hydro Electric Dept., we understand. The English Electric Co., Ltd., were given the order for the associated water turbines for that station. Being constructed on the Waikato River, Atiamuri power station will have a normal operating head of 83 ft. The associated dam is to be 125 ft high and 570 ft long, flanked on one side by an earth embankment, 1,000 ft in length. The project has been designed by Sir Alexander Gibb and Partners, the electrical side having been handled by Merz and McLellan.



H.M. the Queen inspecting the control room at Karapiro power station on the Waikato River earlier this month during the course of her tour of New Zealand's show hydro-electric plant. This station commenced operations in 1947, and has three 30 MW generators installed

Personalities

IN THE INDUSTRY

For the position of manager of its Isle of Wight district, the Southern Electricity Board has selected **Mr R. Lonsdale,** M.I.E.E., who has held a similar post at the Board's Bracknell district No. 1 sub-area, since 1949. Mr Lonsdale served for several years with the Nelson Corporation Electricity Department, holding successive appointments as switchboard attendant, engineer-in-charge, and technical assistant. He went to Salford in 1935 as technical assistant and power sales engineer in the Consumers' Department, and three years later became consumer's engineer at Birkenhead. In 1940 he was chosen for the position of borough electrical engineer to the Brierfield U.D.C., but decided not to take up the appointment, and in 1945 he was appointed deputy borough electrical engineer at Paisley. Two years later he was appointed to a similar post at Reading.

Mr R. Lonsdale

Mr F. Linley

Mr T. W. J. Temple

Commander (E) A. H. Robinson, R.N.V.R. (Retd.), has been appointed London branch manager of Associated British Oil Engines (Marine) Ltd. **Mr K. Schwarz,** B.SC., who has represented the firm in London during the past two years, is returning to head office at Ashton-under-Lyne, on the staff of the sales director.

Chosen as manager of the North Western Electricity Board's No. 1 sub-area is **Mr Frank Linley,** M.I.E.E., A.M.C.T., who has been the Board's purchasing officer since last July. He succeeds Mr H. G. Bell, M.SC (Tech.), M.I.E.E., who is now chief engineer to the Board. Mr Linley, who takes up his new duties on 1 Feb., was mains engineer for the Board's No. 1 sub-area prior to last July. He entered the Supply Industry in 1923, joining the former Manchester Corporation Electricity Department after experience with the Armstrong Whitworth and Crossley Motor companies. At Manchester he held various positions before being appointed chief assistant mains engineer in 1944, becoming mains engineer of the Board's No. 1 sub-area in 1948.

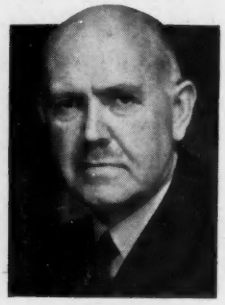
From the British Thomson-Houston Co., Ltd., we learn that **Mr T. W. J. Temple** has been appointed manager of their Middlesbrough office, to succeed **Mr G. Lloyd Jones,** who is shortly taking up another appointment in the B.T.H. organisation. Mr Temple, who holds the Leeds University diploma in electrical engineering, commenced his engineering training as an articled pupil to the city electrical engineer at York, proceeding in 1933 to B.T.H., Rugby, as an ex-University apprentice. In 1936 he took up a staff appointment as a commercial engineer at Rugby and in 1938 was posted to the firm's Sheffield district office. From 1940 onwards he served in R.A.F. Technical Branch with distinction, ultimately as wing commander, and rejoined B.T.H. as commercial engineer, Leeds office, moving to Newcastle district office in 1947. During the last few years Mr Temple has been actively concerned with electrical equipment for marine service both in the Newcastle and Middlesbrough districts on the company's behalf.

Three new senior appointments have been announced by Mr J. B. McRostie, general sales manager of Johnson and Phillips Ltd., in connection with the reorganisation of the company's sales administration. **Mr B. E. Leeson,** who prior to joining J. and P. in 1950 as senior sales engineer (switchgear), was sales manager with Switchgear and Cowans Ltd., becomes home sales manager (plant), and will be responsible for switchgear, transformer and capacitor sales. In his new capacity Mr Leeson will continue to operate from the company's Manchester office. **Mr C. W. Cawte,** B.SC.(ENG.), A.M.I.E.E., who has been manager of the Cable Estimating Department since 1942 and has represented the company on C.M.A. matters for many years, becomes home sales manager (cables) and will be responsible for sales of cables and cable accessories. **Mr D. S. Barwell** joins the export manager, Mr F. C. Morris, as sales promotion manager (export). Mr Barwell has recently returned to this country after an extensive tour of Latin America on behalf of J. and P. and in earlier years has been associated with other export sales organisations.

The Sales/Service Organisation of Hoover Ltd. announce the following appointments: **Mr W. A. Driver** moves from the position of district manager at Leicester, to become South London branch manager with headquarters at Kingston; **Mr G. D. Clancy,** previously district manager, Newcastle, is now Northern branch manager with headquarters at Manchester; **Mr F. W. O'Loughlin,** who was area manager, Bournemouth district, becomes district manager, Leicester; **Mr W. W. Arnold,** formerly dealer liaison manager for the North East at Leeds, is appointed district manager, Newcastle; **Mr A. Hutchinson,** previously district manager, Glasgow North, is now district manager, Birmingham; **Mr P. J. Trot-**

Mr C. W. Cawte

Mr D. S. Barwell



Mr B. E. Leeson

man, recently district manager, Birmingham, moves to special managerial duties in the Contract Department; **Mr G. Hanson,** formerly district manager, Leeds, becomes district manager, Glasgow North; **Mr R. B. Carpenter,** who was representative in the Wigan district, is promoted to district manager, Leeds; **Mr A. H. Cockwell,** previously district manager, Sutton, becomes district manager, Kingston; **Mr. W. R. Walters** moves from the position of district manager, Kingston, to district manager, Sutton; **Mr W. M. Thompson** is transferred from Export Department to the post of district manager, Westminster; **Mr I. K. S. Joll,** formerly district manager, Westminster, becomes sales manager of the Contract Department; **Mr H. F. McColl,** previously supervisor, Glasgow North district, is now district manager at Cheltenham, and finally **Mr J. Hanby,** who was staff instructor, becomes district manager at Portsmouth.

Mr B. A. Robinson, M.I.E.E., M.I.MECH.E., who has been with the Cambridge Instrument Co., Ltd., for 41 years, and has been their district representative for thirty-two years in the Newcastle-on-Tyne area, has now retired. He is succeeded as district representative by his son, **Mr W. E. Robinson.**

At last week's meeting of the Southern Electricity Consultative Council, the chairman, **Group Capt J. C. M. Hay,** O.B.E., on behalf of the members, presented an electric clock to **Mr A. Lockwood** as a mark of their esteem and in recognition of his valuable services to the Council as its chairman for over three years.

The Mersey Cable Works Ltd. have appointed **Mr R. Owen,** A.I.E.E., as sales manager. He was previously area engineer, Central England, for Pirelli General Cable Works Ltd.

Further appointments, with effect from this month, are announced by W. T. Henley's Telegraph Works Co., Ltd. **Mr R. B. Hill,** previously chief assistant sales manager of the Rubber Cable Department, is now appointed manager of Cable Sales Department; **Mr W. M. Baxter,** who was formerly manager of the Export Sales Department, becomes chief assistant manager, Cable Sales Department, and is succeeded by **Mr N. B. Frost** as manager of the Export Cable Sales Division.

Mr G. D. Bond, who was chief accountant of the Derby Corporation Electricity undertaking from 1939 to 1941, has been appointed an additional director of Denbro Ltd., the parent company of the Dennison group of companies.

Mr F. Rostron, M.I.E.E., M.I.EX., export sales manager of Ferranti Ltd., has been elected chairman of the Engineering and Metals Section of Manchester Chamber of Commerce for a further term.

Mr R. C. Harper and **Mr D. G. Willson** have been elected members of the board of directors of Fry's Metal Foundries Ltd. **Mr E. S. Minto** has been appointed secretary of the company.

Mr H. T. Timberlake

Mr J. E. Sunderland

Mr M. J. Smith

At present commercial engineer with the South West Fylde district of the North Western Electricity Board, **Mr H. T. Timberlake,** A.M.I.E.E., has been appointed district manager at West Bromwich, in the North Staffs and South Worcs. sub-area of the Midlands Electricity Board. He takes up his new duties early next month. Mr Timberlake started his career with the Belfast Corporation undertaking, and after also serving with the Electricity Board for Northern Ireland, was appointed engineer and manager of the Brentwood District Electric Supply Co., Ltd., Essex, in 1937. Eight years later he was chosen for the post of deputy borough electrical engineer and manager to the Harrogate Corporation where he remained with the North Eastern Electricity Board until taking up his present position.

Director of the Telegraph Construction and Maintenance Co., Ltd., **Mr W. F. Randall,** B.SC.(ENG.), A.R.S.M., M.I.E.E., F.I.M., leaves London on 30 Jan. for a two months' visit to the company's branches and representatives in Karachi, Bombay, Singapore, Australia and New Zealand, including a visit to the company's estate in Malaya, the Selborne Plantation. Mr Randall is chiefly concerned in promoting increased sales of Telcon metals in those areas.

From Enfield Cables Ltd. we learn of two new appointments. The first concerns **Mr J. E. Sunderland,** A.C.A. who has been nominated director and general manager of the company, and the second is the appointment of **Mr M. J. Smith,** O.B.E., B.SC.(ENG.), D.F.H.(HONS.), A.M.I.E.E., as technical director of the company. Mr Sunderland joined Enfield's in 1946 and has been a member of the board since 1951. He was previously with J. Samuel White and Co., Ltd., shipbuilders, of Cowes. Mr Smith was formerly with the British Electricity Authority. His war service comprised flying duties with the R.A.F.V.R., until 1941. Following a flying accident he then became chief electrical engineer to R.A.F. Bomber Command and subsequently, after demobilisation, Electrical Development Engineer to the Copper Development Association. He joined the B.E.A. in 1950 as chief overhead line design engineer and more recently was promoted power circuits engineer, a position involving responsibility for cable as well as overhead line matters.

Mr F. C. Burstall has been appointed deputy managing director of the Automatic Telephone and Electric Co.

The B.B.C. announces the appointment of **Mr H. O. Sampson** as head of technical operations television studios. Mr Sampson joined the B.B.C. Television service at Alexandra Palace in 1936 and remained there until the service was suspended at the outbreak of war. During the war he served at several of the B.B.C.'s high power transmitting stations and with the London recording unit. Early in 1944 he joined the War Reporting Unit as an engineer-correspondent in the North Western Theatre of Operations. Mr Sampson returned to the television service in 1946 as senior lighting engineer, and became assistant head of technical operations television studios in 1952, which post he has held until taking up his present appointment.

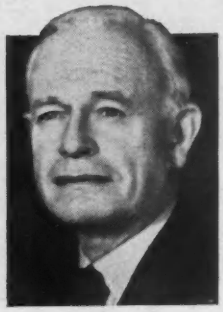
Mr R. B. Hill

Mr W. M. Baxter

Mr N. B. Frost

Mr E. G. Swangren

Mr J. H. R. Nixon



Dr W. B. Whitney

Appointed head of the Operation and Maintenance Section of the Chief Engineer's Department of the North-Eastern Electricity Board, with effect from Feb. 1, is **Mr E. G. Swangren,** M.I.E.E. He succeeds Mr H. Esther who, as we have already noted, has been appointed chief engineer. Mr Swangren joined the North-Eastern Electric Supply Co., Ltd. in 1914, and after service in power stations and in various sections of that company, was appointed chief control engineer in 1938. He later became superintendent, Northern Area, and at vesting date was appointed Sub-Area engineer for the Wear Sub-Area of the Board.

Dr W. B. Whitney, M.INST.C.E., M.I.E.E., recently retired from the Electrical Research Association but is continuing his connection in a part-time capacity, we learn. He joined the E.R.A. in 1920 and built up the Switch- and Control-Gear Department, of which he has been in charge until now. In 1950 he added the duties of assistant director to his other responsibilities. As an engineer his great reputation is particularly associated with the invention, with Mr E. B. Wedmore, of the gas-blast and side-blast oil baffle type circuit-breakers. Nevertheless it is true to say that, having conceived important ideas, he spent most of his time in endeavouring to secure their scientific explanation and the basic principles on which development should be founded. It is for this that members of the Association have had the more direct reasons for appreciating his work, since it so greatly helped their industrial developments which have placed both manufacturers and users in this country in the forefront. Dr Whitney has been all his life an enthusiastic cricketer and played in first-class club cricket for many years, and even when over 50, succeeded in obtaining over 100 wickets in a season. Dr Whitney's retirement will entail certain changes in the E.R.A. organisation: Mr Gosland's Department (Transmission and Utilisation) has been reorganised and will now include the switchgear researches. He will have the assistance of **Dr C. E. R. Bruce** and **Mr A. M. Cassie,** whose work on the physical principles of switchgear is well known. **Dr G. Mole** and **Dr L. H. Orton** will deputise for him on certain subjects. **Mr W. Nethercot** has been appointed Head of the Department of Ignition and Radio Interference.

His numerous friends in the Industry will be sorry to hear that due to persistent eye trouble, **Mr P. G. Wallis** has had to relinquish the position he has held for nearly thirty years as general manager of G. E. Wallis and Sons (Electrical) Ltd. and the Electrical Department of the parent company, G. E. Wallis and Sons Ltd. He is retaining his directorship of the former concern and has been appointed electrical consultant to the parent organisation. He hopes not to lose touch with his friends in the trade.

Sales manager of Gillott Electro Appliances Ltd. **Mr Christopher Gillott** has now been appointed sales manager of New Day Electrical Accessories Ltd. He will manage the sales of both companies, which are subsidiaries of Southern Areas Electric Corporation Ltd., from the New Day Company's works at Mary St, Balsall Heath, Birmingham.

Elected chairman of the East Midlands branch of the Institution of Mechanical Engineers last week is **Mr J. H. R. Nixon,** M.I.MECH.E., M.I.E.E., F.I.I.A., technical director of the Brush Electrical Engineering Co., Ltd. He is a past chairman of the East Midlands centre of the I.E.E. His educational interests include Life Membership of Court of the University of Nottingham and he is a member of the University Engineering Advisory Committee. He is also a Governor of the Loughborough Colleges under the Leicestershire Educational Authority and a member of the Engineering Advisory Committee of the Loughborough College of Further Education, in addition to being a member of the Education Committee of B.E.A.M.A.

Mr W. J. Howard, who was for many years in charge of the distribution side of the Sheffield Corporation electricity undertaking, and whose name is associated with leakage-to-frame (Howard earth leakage) protection, passed his 80th birthday recently. To celebrate the occasion a group of old friends and colleagues entertained him to dinner in Sheffield on 14 Jan.

The Minister of Fuel and Power has re-appointed **Mr W. H. Lawson,** C.B.E., B.A., F.C.A., and **Lt-Col E. L. Luce,** D.S.O., T.D., J.P., as part-time members of the Southern Electricity Board.

Mr Ivan Stedeford, chairman of Tube Investments Ltd., left London by air for India yesterday for business consultations in Bombay, Calcutta and Madras.

Mr A. N. Brighton, B.SC., A.M.I.E.E., A.M.I.MECH.E., has been appointed technical assistant to the Jersey Electricity Co., Ltd. He has held appointments in the Transmission Department of the Uganda Electricity Board since February, 1951, and previously worked for the Southern Rhodesia Electricity Supply Commission for four years. Prior to that, he held appointments with Preece, Cardew and Rider, the Air Ministry Works Directorate, and Edmundsons Electricity Corporation Ltd.

OBITUARY

Mr Eustace Ridley, M.B.E., M.I.E.E., who died on 11 Jan., in his 81st year, was for many years on the Committee responsible for framing the I.E.E. Wiring Rules. He had served with the London County Council for over thirty years, retiring in Jan. 1938 from the position of principal technical assistant (special services) in the Architect's Department. He was assistant engineer with the St. James and Pall Mall Electric Light Co. and chief engineer to Smithfield Markets Electric Supply Co., before entering the L.C.C.'s services in 1906, in the Fire Brigade Department as an electrical and mechanical engineer. In 1911 he was promoted to principal assistant and later to the position of engineer-in-charge (inspection). He was responsible for advising the chief officer of the London Fire Brigade on all engineering questions at places of public entertainment, for the annual inspection of such buildings, and for other special duties. In 1933, in consequence of the Council's decision to place the major part of such work under the direction of the architect, he took up the post from which he retired in 1938. He served for many years on the Standing Committee of the Institution of Electrical Engineers responsible for drawing up of "Regulations for the Electrical Equipment of Buildings."

Mr Charles Remington, who died at Leicester on 11 Jan., aged 68, was for the past 18 years a member of the technical staff of Gent and Co., Ltd., prior to which he was with the A.T.M. Co.

Mr E. Beattie, a director of Keith Blackman and Co., Ltd., died 10 Jan., aged 79.

Mr A. K. MacKenzie, B.SC., technical engineer with the North of Scotland Hydro Electric Board, died on 16 Jan., aged 33.

Mr A. W. Kanis, managing director of Crayonne Ltd., died on 13 Jan.

Mr J. C. MacFarlane, Q.C., vice-president and director of the Canadian General Co., Ltd., has died, aged 64.

Mr E. F. Callahan, who retired in 1950 from the position of vice-president of the International General Electric Co., died on 14 Dec., aged 68.

PROBLEMS AND PRACTICE

In Engineering

Every engineer has a story to tell, why not tell yours on this page. We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.

System Earth Faults

RECENTLY, I had experience with an earth fault on an 11 kV supply system of underground cables. The system, shown diagrammatically in the accompanying sketch, comprises essentially a 12¼ mile feeder energised at one end by a 6·6/11 kV transformer. On the occurrence of the fault, the relay at A operated to trip its O.C.B. and clear the fault, which was eventually located in a straight-through joint box, some 10,700 yds from the feeding point. At the same time, however, or possibly earlier, the relay of D, about 11,500 yds beyond the fault, also operated.

At the time of the fault, the section D—E was only energised, no load being connected to it apart from a charging current of 3·25 amp/phase at 11 kV. Whilst relay A is of the inverse time lag type, with 30 volt d.c. tripping battery supplied; relay D is the direct c.t. operated type with two overload and one earth-leakage trip, the latter circuit incorporating time limit fusing.

Other cases similar to this particular fault have occurred previously, although all spur circuits were then partially loaded. It seems probable that the actual severity of the fault, combined with relay settings, determines which sub-section will clear first (before the main circuit-breaker at the supply end). Section D—E is normally kept energised, to ensure due notice being given of failure of any kind, rather than left open-circuited until required for service. It is problematical whether such unloaded circuits should be left alive and hence subject to rises in voltage due to earth faults on other parts of the system which may, in time, cause the cable to break down. Past experience has shown, however, that a standby cable circuit disconnected over a period can lead to serious trouble. Were the cable to be spiked and left this would not be discovered until the cable was required for service, by when, of course, the damage could be beyond repair. Provided that e/l relays with instantaneous tripping are fitted, I feel that the practice of leaving standby cables "alive" is the more satisfactory condition.—*H. W. R. Ogden.*

Magnetic Brake Trouble

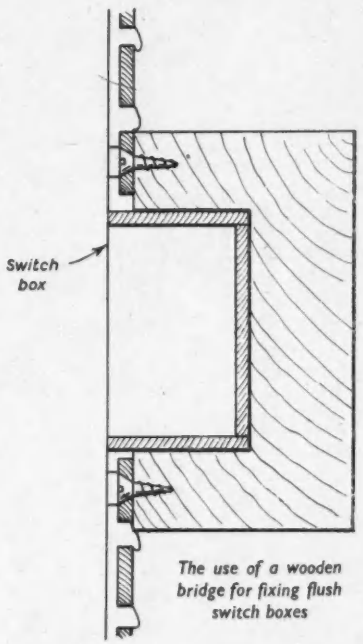
ON the works overhead travelling crane, braking of the three-phase 380 volt hoist motor is effected electromagnetically with the brake drum mounted on the shaft extension at the slipring end. The brake was actuated by a three-phase mounted vertically solenoid magnet in which the three-limbed yoke was attracted upwards when the motor was switched on, thus releasing the brake, which would be reapplied on switching off. The two brake shoes, diametrically opposite, had the usual adjusting bolts to take up wear.

Recently the crane driver noticed smoke coming from the magnet and duly sent for assistance. As the coils had been in use for years it was assumed that just old age, combined with the usual shocks and jars to which the crane was subject, caused the burning out of the magnet. New coils were fitted but after a short period they also were seen to be overheating. Inspection proved that the connections were in order. On questioning the crane driver it came to light that sometime previously the brake had started to slip and he had got a fitter to adjust the brake shoes.

The trouble was now obvious. In adjusting the brake the fitter had restricted the movement of the yoke. Unless this was pulled fully home, the solenoid impedance would be lower that the design permitted thereby causing overheating.—*C. Byrne.*

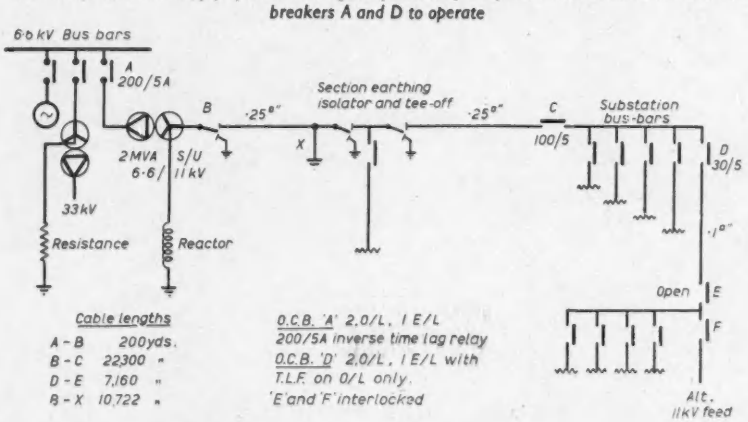
Flush Switch Boxes

AS an alternative to the scheme described by W. Satchwill (24 Dec. issue) for fixing flush switch boxes, I use a wooden bridging piece, as shown in the accompanying sketch. It will be noted that the bridging piece is fixed by screws through small holes drilled in lathes adjacent to the flush box. In my experience it makes a very firm fixing especially as the opening of the piece makes a snug fit to the switch box. It is true that two additional holes are made in the plaster. However, some making good is almost invariably necessary between the external sides of the box and plaster if a clean job is to result, since modern switch cover plates have very little overlap. The advantage over Satchwill's method is that there is no possibility of damaging the far-side wall.—*M.N.*



The use of a wooden bridge for fixing flush switch boxes

Circuit of the 11 kV supply system showing the position of the fault which caused both circuit-breakers A and D to operate

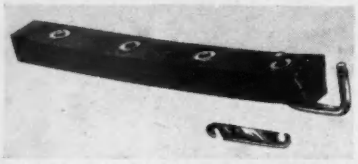


Equipment for Industry

Adjustable Vee-Belting

IN certain machine drives the use of endless vee-belts has often involved difficulties in stretch take-up and correct tensioning. For such installations, an adjustable leather vee-belting, which is now being marketed, should prove of particular value. Known as "Adjusticon," the belting is manufactured by CAROL BELTINGS LTD., 12 Gray's Inn Rd, W.C.1, and is suitable for all applications of vee-belt drives. Success has also been claimed for it in locations where an endless vee-belt has been found inapplicable.

The "Adjusticon" is of multi-ply leather construction, with stainless tubular



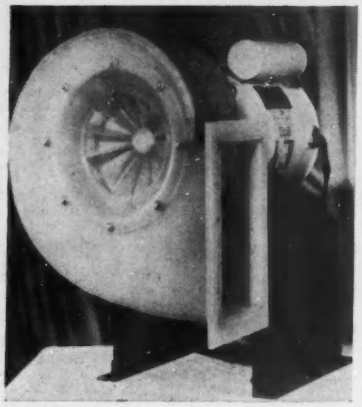
"Adjusticon" vee-belting and the special link

metal eyelets, evenly placed throughout its length, serving to clamp the plies of the belt. By means of these eyelets, and a special link piece, the belt may be adjusted for length and tension on any vee-belt drive. The link piece is held in place by a spring steel plate which clips on to each end of the link in the grooves cut into it, a locking device which, it is stated, may only be released by manipulation. Made in standard sizes, the belt is supplied in coils of 25, 50 or 100 ft.

Exhaust Plant in "Vybak" Sheet

THE corrosion resistant properties of p.v.c. have been put to useful exploitation in the manufacture of a new design of exhaust equipment. Particularly suitable for chemical plant installations, the equipment comprises a series of exhaust fans and ducting constructed entirely from a rigid plastic industrial sheet based upon polyvinyl chloride. Fans in the new range are marketed under the name of "Turbro" and are manufactured, together with the ducting, by TURNER AND BROWN LTD., Davenport Works, Davenport St, Bolton, Lancs. They range in size from the "Turbro" Junior of 300-330 cu ft/min extraction capacity, which are designed for use with fume cupboards and other laboratory work, to the largest —a 15,000 cu ft/min capacity unit. Impellers are driven by f.h.p. motors which, in the Junior model, run at 1,450 r.p.m., is ¼ h.p. in size and may be supplied for operation on either single or three-phase supplies. This model is 2 ft high and 1½ ft. wide, including the width of the motor, whilst the inlet is 6 9/16 in. in diameter and the outlet is 6 in. by 3½ in. with flange.

In all units, casing, impeller and its shaft are fabricated entirely from "Vybak" rigid plastic sheeting supplied by Bakelite Ltd., so that no metal surfaces



Here is the new exhaust fan made by Turner and Brown in "Vybak" sheet

are exposed to corrosive fumes. The casing is bolted to an exterior metal frame, an arrangement which enables 16 equi-arc positions to be provided for the outlet. Units, it is stated, may be easily connected to existing ducting or installed in small enclosed areas. Twelve bladed impellers are used, the shaft on which they are mounted being hollow to permit the entry of the keyed motor shaft, whilst the unit is claimed to be virtually noiseless in operation.

Differential Draught Gauge

AMONG instruments used for measuring differential pressure, one of the simplest is to be seen in a differential draught gauge recently introduced by GEORGE KENT LTD., 199 High Holborn, W.C.1. Its simplicity makes it particularly applicable in the smaller boiler plants. One of its uses is found in the indication of load on pulverising mills, by measuring the differential pressure across the mill, whilst sinter plants and similar equipment provide other fields of application.

For the measuring element a diaphragm-operated mechanism is used. Made of lambskin, the diaphragm divides two pressure-tight chambers, one of which receives the upstream pressure and the other the downstream pressure. Two springs, one in each chamber, support the diaphragm, that in the upstream chamber ensuring its correct direction of movement. The other spring—the "control spring"—is of calibrated strength and governs the operating range.

As the position of the diaphragm varies with the differential pressure, its movement is transmitted to a light, balanced pointer by way of a linkage system through a pressure-tight, hat-leather-type gland. Indication is provided by a clear, vertical, edgewise scale calibrated in differential pressure units, zero-adjustment of the pointer being provided. If the scale is to be internally illuminated, it can be supplied in a translucent material. Consistent operation is stated to be obtained by making the diaphragm of generous proportions, and the manufacturers guarantee an accuracy of ±2% of maximum differential head. Capable of measuring up to 30 in. w.g. differential head, the instrument is available in ranges of 0-2, 0-3, 0-4, 0-6, 0-9, 0-12, 0-16, 0-20, 0-25 and 0-30 in. of differential pressure.

New Grades of Nickel

TWO new grades of wrought, commercially pure nickel for use in electron valves, have been recently announced by HENRY WIGGIN AND CO., LTD., Wiggin St, Ladywood, Birmingham. One of these is known as H.P.A. Nickel, having a minimum nickel content of 99·5%. It is available in strip, tape or wire form, and the makers recommend its use for valve components operating at high temperatures where the evaporation of volatile elements cannot be tolerated. The other grade is H.P.B. Nickel, primarily intended as a material for cathodes where sublimation of magnesium must be avoided due to inter-electrode spacing.

Hand Tally Counter

A COMPACT hand tally counter which can prove of considerable value in numerous application of manual counting is now available from COUNTING INSTRUMENTS LTD., 5 Elstree Way, Boreham Wood, Herts. Housed in a small case of white plastic material, it is held in the hand without difficulty, whilst

Left, the George Kent differential draught gauge and below Counting Instruments' hand tally counter

a finger ring can be provided if required. Its weight is 1½ oz, including chain and finger ring. Operation of the tally is effected by depressing a grooved lever, also in plastic. Counts up to 9999 can be made, with a zero-resetting knob.

Price Changes Announced

CHANGES in the rates of purchase tax and reorganisations have resulted in the announcements by four companies of changes in the prices of certain of their products.

DIMPLEX LTD. and HURSEAL LTD., makers of oil filled electric radiators, have both announced changes in prices of their models following the reduction of purchase tax on electric space heaters from 75% to 50%. Result of this in the case of the former company is that their A38 ½ kW panel model now sells at £9. 5s. plus £3. 7s. 9d. and others pro rata. Hurseals TV ½ model rated at ½ kW now sells at £8. 15s. 6d. plus £3. 4s. 2d. whilst others in the range have similarly benefitted from the purchase tax reductions.

H.M.V. HOUSEHOLD APPLIANCES also announced reduction in the prices of their electric fires and convecter heaters. Their F.R.F.I. Portman reflector fire rated at 1 kW now costs £3. 2s. 6d. plus £1. 2s. 10d., a total of £4. 5s. 4d., whilst the H.C.2 Cavendish Room Heater costs £8. 8s. plus £3. 1s. 5d. tax, a total of £11. 9s. 5d. Other models also reduced.

BRITISH CENTRAL ELECTRICAL CO., LTD. announce that as from Jan. 11 the price of their B.C.E. full load earth tester has been reduced from £24. 0s. 0d. net trade to £22. 10s.

New Prestcold Refrigerators

FIRST of a pair of new models introduced by the PRESSED STEEL CO., LTD., Cowley, Oxford, is the self-contained model SC 175, which provides short-period storage of perishable foodstuffs and frozen foods together with ice cube production. Attractive in appearance and of all-steel construction the SC 175 has a gross capacity of 17·1 cu ft; a frozen food locker of 1·7 cu ft capacity is fitted which combines with it the ice-cube making unit. (Three trays are provided to make 42 cubes or 4½ lb ice). It has a deep white vitreous enamelled acid resisting "Crispator" specifically designed for the moist storage of vegetables and salads and a chill tray for the storage of wet fish, etc., under the cooling unit.

The SC 175 in common with the SC 176 is fitted with the silent vibrationless "Presmetic" power unit.

The SC 175 Prescold refrigerator is very roomy

The SC 176 is designed for the short period storage of perishable foodstuffs. Generally similar to SC 175 it differs from it in the absence of the frozen food locker and the centralising of the cooling unit.

Both models are 44½ in. wide, 28¼ in. deep, and 68¼ in. high, weight 525 lb.

Osram Universal Starter Switch

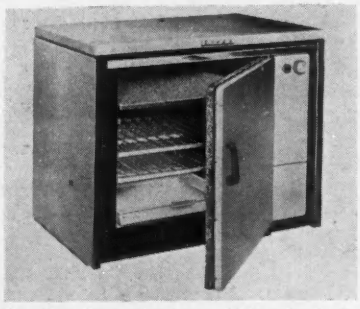
FOR the convenience of users of Osram fluorescent tubes in switch start circuits, THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has introduced a universal starter switch (OS 345 Model S.T. 26) for use on the voltage range 200/250 V a.c. with 3 ft, 4 ft and 5 ft tubes. The new starter covers the duties hitherto performed by four different units. It is interchangeable with other universal glow starters. The price is 6s.

4½ cu ft Oven Added to Creda Range

CONFORMING to the Creda unit type specification of heavy duty cooking equipment is a 4½ cu ft general purpose roasting oven, Model HC 4905.

With this introduction SIMPLEX ELECTRIC CO., LTD., Broadwell, Oldbury, Birmingham, have unit type ranges in two sizes, unit type boiling tables in two sizes, and unit type roasting ovens in two sizes, which will allow for greater flexibility in meeting the requirements of catering establishments.

Special features other than those common to the Creda unit type cooking equipment range include 100% oven capacity, door opening full 150°, a close-fitting oven door with concealed adjustable oven ventilators, fully automatic heat control by two stage thermostat to give fast initial heat up and easy replacement of fuses, thermostats, switches



This 4½ cu ft oven has been added to the Creda range

and elements from the front—an important point when units are butted together.

Dimensions of the HC 4905 are 2 ft 10 in. height, 2 ft 11½ in. wide, 2 ft 4½ in. deep. Oven measures 18 in. x 18 in. x 24 in. and loading is 44 kW.

Ceiling fitting by Philips

THE "Athlone" (Cat. No. 6020) is a new ceiling fitting produced by PHILIPS ELECTRIC LTD., Century House, Shaftesbury Ave, London, W.C.2, It uses 5 ft 80 W lamps and sells at the low figure of £5. 10s. (excluding lamp).

It is especially designed for rapid and easy fixing at any centre from 36 in. to

For the Electrical Trade

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51 in. and all control gear and wiring are mounted on an independent gear chassis extending the full length and width of the reflector covers. This

The "Athlone" is a new Philips fitting

arrangement lends to the fitting a smooth, clean line, unmarred by a projecting starter switch.

Although designed for flush ceiling mounting, it can be suspended by chain or by conduit as well. In addition, provision is made in the centre of the gear chassis for B.S.S. conduit box fixing, and for cable entry.

The "Athlone" (which measures 64¾ in. long by 3¾ in. wide by 5¼ in. deep over lampholder covers) is finished in high-grade white stove enamel.

Kingswear Control Units

WELL styled consumers control units in two types are available from SARUM ELECTRIC LTD., Catherine Court, Catherine St, Salisbury, Wiltshire.

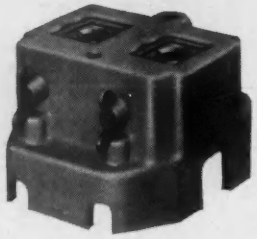
The Kingswear Type 30 control unit is a substantial sheet metal container with detachable architrave and double-panelled door hinged down one side with ball-catch fastening. The unit contains a detachable 12 in. × 14 in. meter board which need not be removed when fitting the unit. The pattern for houses has a slotted opening and provision for the service cutouts allowing the service cable to be made off and laid back before the architrave and door are fitted. Internal wiring is enclosed and protected by a detachable cover and channel leading from the meter board to the 60 amp main switch and fuse bank. Fuses can be supplied in any combination of 5, 15 or 30 amp up to eight ways in rewireable or cartridge type. Trade prices range from £4. 11s. for a 4-way rewireable fuse pattern for flats to £6. 1s.

for an 8-way cartridge fuse house pattern unit.

A further type 40 has been designed to provide an inexpensive main switch and fuse box suitable for single pole fused wiring. It is a sheet-metal box with detachable lid, containing a 30 or 60 amp d.p. main switch porcelain rewireable type fuses and a neutral connector. The lid is locked with the switch toggle to prevent inadvertent opening. Surface mounting only is available finished in cream stove enamel. This unit without fuses costs between £1. 10s. 6d. trade price for Cat. No. 304 A for 4-way 30 amp unit to £2. 1s. 3d. for Cat. 308, the 8-way 60 amp unit.

Mazda Holder for bi-post Lamps

A NEW Mazda bi-post lampholder has recently been developed for use with 1 kW, 2 kW, and 5 kW Mazda Studio Lamps, and 2 kW and 5 kW Colour Temperature Lamps, announces



This new holder is for bi-post lamps

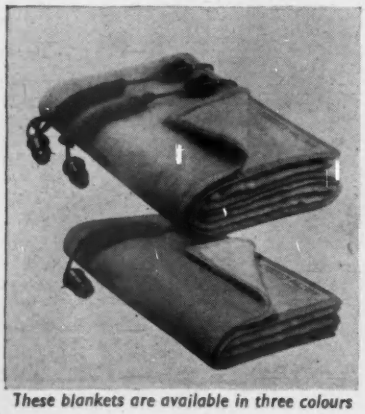
the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, W.C.2.

Cast in aluminium alloy, this lampholder combines the positive retension of the lamp—achieved by the use of wing-nut clamps—with fully floating sockets that exert no strain on the lamp terminals, whilst ensuring a complete electrical contact. The price is £3. 3s. with no purchase tax.

Comforting Sleep Helped by Pifco

LUXURIOUS warmth and comfort in bed is claimed to be ensured by the use of the new de luxe electric blankets introduced by PIFCO LTD., Watling St, Manchester 4.

Soft fleecy all wool blankets of full length in Gold, Peach or Powder Blue colours with slub rayon crease-resisting



These blankets are available in three colours

undercover and bound with whipped edges these Pifco products are constructed according to the draft British Standard Specification No. 4702. The double bed size (60 in. x 40 in) loaded 125 W has two separate control switches allowing either half of blanket to be used independently. Triple wound self-compensating elements cause no electrical interference and are secured on duck interiors. All models are fitted with 9 ft braided circular flexible cable, an indicator switch and a combined plug adaptor. They are packed in a Pifco display carton with guarantee and instruction card.

The single-bed size (60 in. x 27 in.) is loaded at 85 W and is priced £7. 4s. plus £1. 6s. whilst the double-bed size costs £10. 8s. plus £1. 17s. 7d. tax.

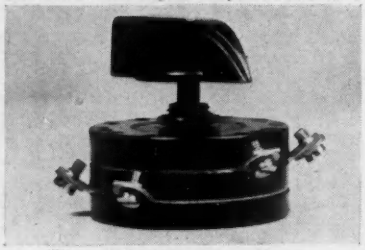
New Industrial Coffee Percolator

CONSTRUCTED from heavy gauge copper finished in chromium plate, the new heavy duty coffee percolator produced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, is available in one and three gallon sizes. It operates on the same principle as the ordinary household coffee percolator and provides perfectly brewed coffee at any time as required.

The interior is silver plated, as is the coffee basket and the water is heated by copper sheathed strip elements clamped to the inner base of the body. Control is by three heat rotary switch, whilst a safety cutout is provided to operate if the percolator becomes dry. A full bore draw off tap is fitted with an easily cleaned plug whilst coffee basket and lid stand on the perculator tube and support. The one gallon model is loaded at 1 kW is 9¼ in. diam., 16 in. high and costs £19. 15s. and the three gallon size rated at 2 kW stands stands 21¼ in. high x 10⅜ in. diameter and costs £24. 3s.

12 Ways With This Switch

A ROTARY switch just introduced by CRATER PRODUCTS LTD., The Lye St. Johns. Woking. Surrey. is rated at 5



This switch controls up to 12 ways

amp 250 V and can control any number of poles with an extensive selection of circuit combinations up to 12 ways. Yet this switch is only 1⅝ in. in diameter. It can be supplied with a variety of fixing terminals and has low contact resistance.

TRADE PUBLICATIONS

ELECTRIC FURNACES.—The growing use of the melting and heat treatment plant adds interest to the first of a new series of catalogues and brochures which Birlec Ltd., Tyburn Rd, Birmingham 24, now has available for distribution. A folder describing the recently introduced BE 40 Lectrodryer air conditioning unit designed for continuous operation in self-contained areas, a pocket-sized card folder of Humidity Tables, revised brochures dealing with: Shaker Hearth Conveyor Furnaces: Gas Carburising: Electric Furnace Brazing: and the Machine Tool Approach to Surface Hardening are available. There is also a new 20-page descriptive catalogue of Birlec Lectromelt Arc Furnaces and a publication describing, under the heading Machine Tool Approach to Production Heating, the induction heating equipment developed by Birlec Limited.

SWITCHGEAR.—New literature now published by Bill Switchgear Ltd., Aston Lane, Perry Barr, Birmingham 20, includes a 2nd edition of No. CR 1253 leaflet on Bill "Crown" switchfuses and switch splitters, a new leaflet CRP 1253 for Bill "Crown" Pilot switches and switchfuses both giving revised prices, a booklet on the history of the company and a booklet entitled Birmingham Electric Supply in 1891.

MOTORS.—A leaflet issued by Newman Industries Ltd., Yate, Bristol, describes the use of Newman motors at the works of Morris Motors.

WIRES AND CABLES.—Of interest to our readers concerned with motor winding will be the two booklets on Lewmex wires and rectangular sections now available from the London Electric Wire Co., and Smiths Ltd., 24 Queen Anne's Gate, S.W.1.

SILICONES.—Prepared for the motor user a booklet "Silicones in Motor Windings," issued by Midland Silicones Ltd., 19 Upper Brook St, W.1, deals in a general way with the advantages of silicone insulation.

LIGHTING.—Glass lighting fittings are the subject of Catalogue No. 799 issued by Falk Stadelmann & Co., Ltd., 91 Farringdon Rd, E.C.1.

WASHING MACHINES.—A folder of information on the firm's products has now been issued to 1,800 Fisher Stockists throughout the country by H. Fisher (Oldham) Ltd., Oldham, Lancs, and copies are available on request.

FLUORESCENT LIGHTING.—Fluorescent lamp control gear is described in a neat pocket booklet issued by Smart & Brown (Engineers) Ltd., 8 Rose and Crown Yd, S.W.1.

AIR-PUMPS.—Turbo exhausters and blowers are featured in a brochure 5602 published by the Sturtevant Engineering Co., Ltd., Southern House, Cannon St, E.C.4.

SWITCHGEAR.—The PM 45 Earth leakage circuit-breaker developed by Siemens Electric Lamps and Supplies Ltd., 38-39 Upper Thames St, E.C.4, and described in our issue 24 Dec. is now featured in a new leaflet Z 203/53.

NEWS OF THE WEEK

U.K. can satisfy Overseas Demand

Manchester Chamber of Commerce review of Electrical Industry

THE major portion of the electrical manufacturing industry is now able to satisfy all overseas demands for its products, without in any way jeopardising its supplies to the home market, states the annual report of the Engineering and Metals section of Manchester Chamber of Commerce. Chairman of the section is Mr F. Rostron, export sales manager of Ferranti Ltd. In an admirable review of the electrical industry during 1953, it is stated that the industry has maintained its position as the second largest exporter, but exports were showing a downward trend which would probably amount to 5% below 1952. At present that decline was mainly in domestic appliances—due largely no doubt to import restrictions by certain overseas markets resulting in reduced shipments to Pakistan, Australia, New Zealand, Finland, Turkey, Egypt, Brazil and Argentina—but the natural trend was for capital goods to follow.

A healthy export turnover required the backing of a firm basic home market, it is pointed out, and time was rapidly approaching when it would be imperative to cancel or reduce considerably purchase tax and hire purchase restrictions, and accelerate the B.E.A.'s development programme. A healthy normal home market would thus be assured with the added advantage of a more plentiful and cheaper supply of electricity. The report goes on to state that h.p. per man would be increased and production cheapened, and British goods would be more competitive in those markets where foreign competition was slashing prices to a level uneconomic for our electrical industry.

Radio and television have had a bumper year, and the former had more than held its own against the popularity of television. The textile industry had shown itself to be increasingly dependent on electrical aids.

The industry's contribution to reducing atmospheric pollution and conserving fuel resources is also dealt with. Although power stations use 16% of coal produced, they emit only 0·4% of the smoke, the report states, and adds that constant research is being carried out into means of using more inferior coal.

On more general subjects, the section urges a more balanced state of international finance and increased rate of overseas capital investment. To many exporters the most immediate problem was the financing of extended credits which customers were demanding. It is understood that negotaitions were making progress in banking and commercial circles to provide the necessary facilities.

Following an improvement in delivery times and firmer price quotations, attention is now being directed towards costs. The report states that much remained to be done in the drive for greater productivity and efficiency. An urgent need was for more factory re-equipment and modernisation, and here the vital element was taxation. It is strongly emphasised that a further reduction in taxation of industry would not only give a stimulus towards higher productivity, but also reduce manufacturing costs, with consequent beneficial results on exports.

Census of Production serves no Useful Purpose

THAT Censuses of Production served no useful purpose for industry and commerce is the opinion of the Association of British Chambers of Commerce expressed in a memorandum to the Board of Trade Committee, which asked for their views. It is pointed out that the length of time taken to collate the information and make it available, made the findings hopelessly out of date. It is presumed that the only reason for the censuses is to provide the Government with facts on which to base forward economic planning, but grave doubts are expressed about the usefulness of the facts for that purpose also. The Association suggests the Government should abandon the censuses and make more use of statistics and records maintained by most trade associations.

TRADE MISSION TO MOSCOW EXPECTS TO LEAVE NEXT WEEK

BRITISH businessmen planning to visit Moscow for trade talks expect to leave this country next week. It was announced shortly after we went to Press last week that the Russian Trade Representative in the U.K. had informed the party that permission had been given for them to discuss trade matters with the All-Union Chamber of Commerce in Moscow. The team now awaits the issue of visas and necessary travel arrangements.

The team of 30 business executives will be led by Mr J. B. Scott, sales director of Crompton Parkinson Ltd.; and it is emphasised that the mission is a private enterprise venture to develop Anglo-Soviet trade. The Board of Trade has informed the group that it has their support.

As reported on 10 Dec. the trip was postponed until after Christmas as there was some delay in obtaining the necessary permission and documents, and members of the party understandingly wished to spend the holiday at home. Apart from those firms mentioned in our previous report, we note now that representatives of Blaw Knox Ltd. and Ruston and Hornsby Ltd. will also be travelling.

Minister speaks on Current Fuel Position

A BRIEF comment on the current fuel situation was made by Mr Geoffrey Lloyd, Minister of Fuel and Power, at a luncheon in Birmingham last week. During 1953, the Minister said, for the first time since the war, there had been no power cuts of the kind which had become so familiar. The country was not yet out of danger of power cuts, but we faced the coldest time of the year in a stronger position than in any other post-war year. Mr Lloyd added that power stations had large coal stocks, and the B.E.A. and manufacturers of plant had not only greatly increased generating capacity but also increased efficiency.

NOVEMBER SALES OF RADIO AND TV SETS

ONCE AGAIN the monthly figures of sales of radio and television sets have set new records. Details were given last week by the R.T.R.A. of sales during November when the television figures were the best since the coronation and those for radios the highest so far recorded in 1953. The average number of TV sets sold per shop in the month under review was 16 compared with 15·27 in October and 12·95 in November, 1952. Similar figures for radio sales were 10·07 sets during November last, 10·01 in the preceding month and 7·53 in the corresponding month of 1952.

Further Strike Action threatened by E.T.U.

WITH events happening so quickly this week in the strikes of men in the electrical contracting industry, each successive day brings a further development in the situation. The one day national strike of operatives, called by the Electrical Trades Union took place on Monday. On Tuesday a number of these men were locked out, in conformity with the reprisals threat issued by the National Federated Electrical Association.

As the Union had declared that they would extend the national stoppage for an indefinite period if the employers took those counter-measures, the position had reached a very fluid state at the time of going to press.

The "guerilla" strikes planned by the E.T.U. took place at various sites on different days last week. According to a statement issued by the Union about 1,000 members struck on Thursday. Commenting on Monday's strike the N.F.E.A. state that support was far from unanimous and infinitesmal in many places.

One Manchester contracting firm, W. H. Smith and Co., Electrical Contractors Ltd., last week threatened to dismiss all the men employed at one of their factories in the Manchester area if they took part in Monday's strike.

It was claimed by the firm that the factory on the Shepley Industrial Estate was engaged on electronics and was not a contracting site, therefore, the E.T.U. was wrong in instructing the operatives there to strike. Mr W. H. Smith, chairman and joint managing director of the firm, told the men that an agreement, reached in the presence of an E.T.U. official, utilised N.F.E.A. conditions on statutory holidays and overtime rates, and that the men were paid the basic N.F.E.A. wage plus bonus rates. As they were operating the portions of the agreement which conceded increases to certain sections of the workers, he considered the basic premise that the works was not a contracting site was still in being.

Nevertheless, the area secretary of the E.T.U. maintained that the union considered the men came under the terms of the contracting industry.

Refrigeration Luncheon

THE British Refrigeration Association have announced that their next annual luncheon will be held at the Connaught Rooms, London, on 19 Mar. Principal guest will be the Rt. Hon. Lord Mancroft.

ELECTRICAL INDUSTRIES CLUB'S FIRST LUNCHEON

THE inaugural luncheon of the new Electrical Industries Club took place at the Connaught Rooms, London, on Tuesday of last week. Close on 100 founder members and their guests were present, and Mr A. B. Wildsmith presided. Future meetings will be held on the second Tuesday of each month when it is hoped members will be addressed by a guest speaker. Membership is open to male principals, directors or managers of electrical firms or the supply authority, executives whose main interest is in commercial trading, and persons of responsible standing in the industry or closely connected with it. Interested persons are invited to communicate with the hon. secretary, Mr W. E. Babb, at 103 Kingsway, London, W.C.2.

The committee pictured at the Club's first luncheon (left to right) are Mr E. B. Sawyer, Sir Henry Self, Messrs R. Baldwin, J. J. Thompson, A. B. Wildsmith, W. E. Babb, H. F. Wickham, H. de A. Donisthorpe, J. H. Campion, E. G. Batt, H. Senior Fothergill, J. M. Hawkins and N. H. Codling

Lighting for Textiles

APPLICATIONS OF specialised lighting for the textile industries were demonstrated at a special exhibition held in Manchester last week by Thorn Electrical Industries Ltd. Displays included industrial fittings and trunking and also the use of the company's fluorescent lighting for inspection purposes. The U.V. tube for detecting oil stains and other defects in woven material was effectively demonstrated. Thorn's research into the development of fluorescent dimming was given prominence, especially as regards the display of fabrics. The exhibition took place at the company's showrooms in Stevenson Square.

OFFICIAL PUBLICATIONS

BRITISH STANDARD.—B.S. 2067: Determination of Power Factor and Permittivity of Insulating Materials, (Hertshorn and Ward method).

BRITISH ATOMIC FACTORIES.—Available from H.M.S.O., 5s. (see page 96).

INTRINSICALLY SAFE ELECTRICAL APPARATUS AND CIRCUITS.—Test and Certification of. Ministry of Fuel and Power Testing Memo. 10. H.M.S.O. 6d. (see page 89).

REPORT OF H.M. INSPECTOR OF MINES, 1952. N.Eastern Div. H.M.S.O., 1s. 9d.

T.V. ADVISORY COMMITTEE. Second report on sound broadcasting at higher frequencies. H.M.S.O., price 1s. (see page 85).

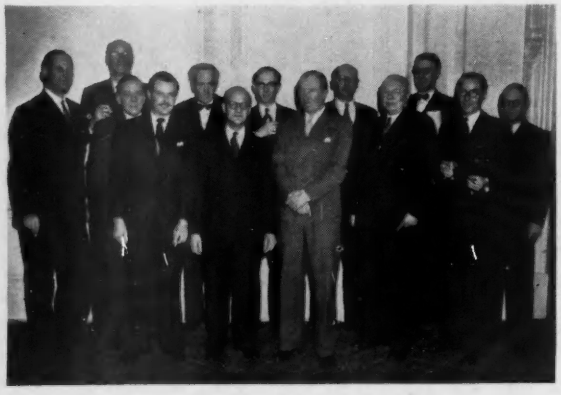
Blinking Beacons Abroad

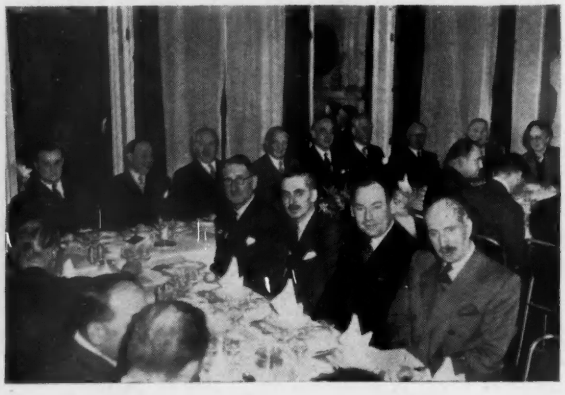
FLASHING beacons for pedestrian crossings has spread overseas to Singapore, where experiments have been carried out. Apparently the trials have proved successful because Venner Ltd. have received an order for synchronising flashing units for installation in all main thoroughfares. We hear Denmark and Holland are also experimenting.

BIMCAM's Tenth Luncheon

THE British Industrial Measuring and Control Apparatus Manufacturers' Association, more familiarly known as BIMCAM, held their 10th annual lunch at Brown's Hotel, London, on 12 Jan. This body now represents manufacturers of over 90% of industrial instruments, which by increasing efficiency have probably done much to keep U.K. prices competitive overseas. A notable achievement of this Association was its part in organising the Instrument Industries Exhibition last July.

Our photograph below was taken at the luncheon, and on the top table (left to right) are Messrs A. Smith, president of Scientific Instrument Manufacturers' Assoc.; W. G. Thomas, chairman BIMCAM; Col. Sir Harold Smith, chairman Gas Council; Messrs H. W. Blake, president BIMCAM; D. Wilson, chairman Council of British Manufacturers of Petroleum Equipment; W. G. Ardley, founder BIMCAM; W. C. Kill, president Instn. of Water Engineers; H. W. Arkell, deputy chairman BIMCAM; and Miss H. V. Lupton, M.o.S.





A general view of one of the North Western Board's "Try It Yourself" Exhibitions

Try It Yourself Exhibitions by N. Western Board

AT Oldham last winter, the first "Try It Yourself" exhibition was staged by the North-Western Electricity Board as an experiment. Since that time, the idea has grown beyond the experimental stage, and has proved so popular and successful a venture that the displays are now a common feature of the Board's activities. So far this winter ten of these exhibitions have been held, each attracting large attendances, and plans have been laid for a further fourteen shows. Set display pieces have been designed by the Board for the exhibition of the various appliances, and at present three of these exhibitions are "on the road."

The idea of the displays is amply explained by the title. All types of appliances are on view, and housewives and husbands are invited to go along and try them out for themselves. One of the most popular attractions is "Hubby's Corner" where Father can try out electric tools and other workshop gadgets.

Invariably the exhibitions are held at central halls and often opened by local civic dignitaries. At some of them, the B.B.C.'s television and radio cook, Miss Marguerite Patten, has given demonstrations on the opening day.

EFFICIENCY OF METERS QUERIED IN COURT

THE Judge's opinion of the accuracy of electricity meters was not high when a case involving the payment or non-payment of a quarterly bill was heard at Hastings county court last week. Judge Archer, Q.C., remarked that the Board appeared to have a higher regard for the machines than he had, and said he knew the odd tricks they could play. If there was any dispute, the thing to do was to charge according to the corresponding quarter of the previous year, unless conditions had changed, Judge Archer said. He added that it was the Board's duty to be careful and accurate and see that they did not charge too much.

A claim for £9. 16s. 7d. made by the S.E. Electricity Board was refused. The Board maintained that this was the amount registered by the meter, and that because of the large amount, it was checked and found correct, checked again and found to be only slightly in error. The consumer stated in evidence that the bill, which was for the first quarter of 1953, was excessive. For the same quarter in 1952 it was £4. 7s. 2d. It was agreed that £5 should be paid to meet the bill.

Housecraft Advisers Confer on Tuesday

PROGRAMME for this year's Electrical Housecraft Advisers Conference, organised jointly by the E.D.A. and E.A.W. was issued last week. The conference will extend over four days and opens at the Royal Empire Society Hall in Craven St, W.C.2, next Tuesday. Over 300 women electrical housecraft advisers and senior demonstrators are expected to attend.

Sir Henry Self is to give the opening address, and will be followed by Col B. H. Leeson. Dame Caroline Haslett will be in the chair. The afternoon will be devoted to a talk and cooker demonstrations by the B.B.C.'s Marguerite Patten, whilst in the evening, delegates will repair to the I.E.E. for the annual Caroline Haslett Trust Lecture. Wednesday's talks at the same venue will be on "Freezing Food for Preservation Freezers, Conservators, Refrigeration" (Anne Smith); "Water Heating—from the Selling Point of View," (Philip Honey); and "Prizes and Awards in the Electrical Industry" (Vera Norvick and J. A. Stedman).

Thursday's proceedings will be at Olympia, where the Hotel and Catering Exhibition is being held. A talk on commercial catering in the morning will be followed by a tour of the exhibition after lunch. At the Connaught Rooms on Friday, a discussion on general topics raised at the conference will precede the traditional luncheon.

SEVEN BRITISH DISPLAYS IN ITALY DURING 1954

MANUFACTURERS interested in the Italian market will be interested in the British Chamber of Commerce for Italy's organisation of Collective Exhibitions. The Chamber is arranging seven such displays at Trade Fairs during 1954 and U.K. firms are able to take part at a comparatively low cost. The first event on the programme is the Verona Agricultural Fair which will be held between 7 and 15 Mar. This function attracted over 600,000 visitors last year. Full details may be obtained either from the Fair Secretary at the Chamber's office in Corso Venezia 37, Milan, or from their London correspondents, Auger and Turner Group Ltd., Autur House, 40 Gerrard St, W.1.

The other six exhibitions will take place between May and October. The Bologna Fair, which includes an electrical domestic appliance section, will be held between 8 and 22 May. Then there are the 9th International Mediterranean Fair at Palermo from 5 May to 10 June; the International Samples Fair at Padua in mid-June; the 18th International Levant Fair at Bari between 9 and 27 Sept.; the International Exhibition of Food, etc.; at Parma, usually held in September, and finally one of the most important, the International Technical Exhibition at Turin. This last includes plastics, television and other electrical sections, and is usually held late in September or early in October.

E.W.F's. Annual Dinner

THE Electrical Wholesalers' Federation have informed us that their annual dinner will take place this year at the Dorchester Hotel on 18 Mar. Time, as previously, will be 6.30 p.m. for 7 p.m. The dinner will be preceded by the Federation's annual general meeting at the Waldorf Hotel.

The First Half-Century

In very cold weather it is often very difficult to keep the hand warm when holding the steering wheel. It occurred to an American electro-motorist that current from the driving cells might readily be caused to heat resistance wires arranged inside the wheel, and thus keep the latter and consequently the hand grasping it, at a comfortable and uniform temperature. He claims that the expenditure of energy necessitated by his device is almost negligible, and that in those petrol cars in which a dynamo is used in connection with the ignition system, the invention can be applied most readily. In cars employing accumulators and high-tension coil, greater difficulty would be met, but as the latter system is almost universally used, a simple attachment for connection to the existing ignition system would be much in demand. Electric vehicles, naturally, present no difficulties.—*From our issue of 21 Jan., 1904.*

Engineering Employers State Case Against Increase in Wages

ORDERS for the year ended May last were 25% down compared with the previous year, and followed a decline of over 8% as against orders for 1950-51. This was stated by Mr B. Moriarty, director of the Engineering Employers' Federation when submitting the employers' reasons for rejecting a 15% increase in wages claim at the Court of Inquiry which began its hearing last week. He said that export figures alone showed a further decrease of 20%, after a decline of some 12½% the previous year. Later, he "very conservatively" estimated the annual cost of the wage claim at about £110 million.

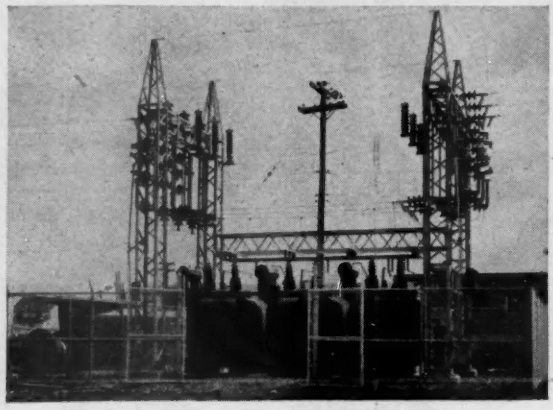
Earlier, Mr J. Tanner, in presenting the case for the Confederation of Shipbuilding and Engineering Unions, explained that their claim was based on three factors: the rise in the cost of living, spectacular increases in productivity in the industry, and the large and continuous rise in the employers' profits. The hearing continued this week.

Board's Claim for Payment

IN last week's issue we reported a case before Brentford county court in which we stated that the S.E. Electricity Board was suing a woman for payment of an outstanding debt of £13. 19s. 3d. for electricity supplied. The Board have written to say they were not suing for the debt as this had already been done, and the question of responsibility for payment decided against the defendant. Proceedings at Brentford were merely for the enforcement of the previous order.

Railway Signalling

THE London National Lecture of the Association of Supervising Electrical Engineers was presented last Tuesday at the Lighting Service Bureau, 2 Savoy Hill, when Mr J. P. Coley dealt with Railway Signalling. He described first the function of a signalling system and then considered in considerable detail the contribution that electricity has made to the speeding up and efficient handling of rail traffic.



A new 30 kV outdoor sub-station at St. Hubert, Quebec, which has recently been put into operation. It is equipped with three 1,000 kVA single-phase, 50 c/s transformers supplied by Denis Ferranti Co. Ltd., of Royton, Lancs.

Board Offers Advice to Industry on Tariffs

UNBIASED advice on selecting the most economical of eight industrial tariffs is being offered by the Merseyside and N. Wales Electricity Board to industrialists in the area. This was decided at a meeting of the Board's Productivity Group last week. The offer might well be regarded as an answer to the criticism levelled against the tariffs by a Widnes industrialist, reported in our 7 Jan. issue. It will be recalled that a campaign to alter or abolish the tariff was threatened and main objections were against tariff 6. The Board pointed out that industrialists had the choice of eight tariffs and it was their responsibility to choose the most suitable one.

At the Productivity Group's recent meeting, four representatives of industry were present, and there was an informal discussion on ways in which electricity could help greater production. The four explained that many smaller factories did not fully appreciate the implications of tariffs. It was those small concerns, moreover, which produced about 75% of the country's manufactured goods. They suggested that the little firms would benefit by advice from the Board's experts, and a list of 450 companies was provided.

The Board's Productivity Group, incidentally was formed only recently. Its purpose is to ensure the most efficient use of electricity. The Group consists of members of the Board's commercial staff.

Colour in Fluorescent Lighting

IN Fig. 4 of the article, under the above heading by Mr W. A. Stickley, of Ekco-Ensign Electric Ltd., which appeared on page 50 of last week's issue, the designations a and b to the two curves should be reversed. The dotted curve, therefore, refers to series capacitor circuits and the solid line curve to choke circuits.

NEWS IN BRIEF

At the request of the Science Museum, Marconi's Wireless Telegraph Co., Ltd., have provided a working demonstration spark transmitter and coherer to receive with morse inker, similar in principle to the original apparatus used by Marconi in early experiments.

The F.E.18 Ultrasonic Panel of the British Welding Research Association is considering the need for a standard, single-hole, steel reference block for use in ultrasonic testing. Interested persons are invited to contact the Association for the details.

First International Instrument Exposition, sponsored by the Instrument Society of America, has already received contracts from 287 exhibitors for 573 booths.

The "Mersey Room" of the Liverpool Store of Lewis's Ltd., described on page 6 in our issue of 7 Jan., 1953, was designed by Misha Black and not as stated in the text and caption to the illustration.

Pyrene Co., Ltd., have bought the whole of the share capital of the Pyrene Manufacturing Co. of Canada Ltd. The cost to the British firm is $675,000, and date for the completion of purchase was agreed as 14 Jan.

Contract valued at over £70,000 has been secured by the General Electric Co. for hot cathode and cold cathode fluorescent lighting installation in workshops and offices of the new B.O.A.C. headquarters at London Airport.

Under the title "Coal—our wasting asset" the February issue of *Mining Review*, a monthly ten-minute newsreel produced for the National Coal Board, deals with the efficient use of fuel in industry and the home.

First of forty-eight 1105 h.p. diesel electric locomotives being loaded aboard s.s. "Gloucester" at Liverpool last week for shipment to Western Australia. Electrical equipment was made at Metropolitan-Vickers' Sheffield and Trafford Park works; the mechanical parts and erection by Metropolitan-Vickers, Beyer, Peacock Ltd.; and diesel engines by Crossley Bros. Ltd. The contract is valued at £2¼ millions.

INDUSTRIAL MAINTENANCE

A special monthly section of the Electrical Times

Planning a Works Distribution System

Part I Voltages and Cabling

by a Steelworks Electrical Engineer

IN this and succeeding articles it is proposed to discuss some of the problems with which the works electrical engineer is faced, and the underlying principles on which a works electrical system is planned. It is hoped that these will be found of general interest and that they will assist those in the manufacturing and supply industries in appreciating some of the user's difficulties. Since conditions vary enormously from industry to industry and with the size of the organisation it is not possible to do more than indicate fundamental ideas. In the following pages the choice of an economical method of distribution considered.

Overhead Lines

Transmission by overhead line is always a more economical method than that using underground cable, due to the cheapness of construction and installation. The opportunities for overhead line construction are, however, rare in factories due to limitations imposed by heights of buildings, interference by cranes and general difficulties of securing adequate clearances. Compared with a cable an overhead line has a much higher incidence of faults, though some of these will be of a transient nature, and the number of outages to be expected will in general be considerably greater. Construction practice is well established and it is proposed to deal only with one or two points before considering the electrical problem of a works system.

Controversy has raged for many years on the relative merits of earthed and unearthed neutral systems, continental practice having in the past been strongly biased to the latter. Unearthed systems find some advocates in this country for works 3·3 kV services when large machines may be connected directly to the supply, the advantages claimed being that a motor may develop an earth fault without damaging the windings and need not immediately be taken out of service, as would be the case if the neutral were solidly or resistance earthed. With this arrangement the neutral is connected to earth via the primary of a potential transformer, the secondary of which energies an alarm device. Whilst this system may be satisfactory with a cable network there is a danger of "arcing grounds" being formed if overhead lines are used to any extent, and an earthed neutral should be considered essential.

In factory areas atmospheric pollution is fairly concentrated, and if steel poles are used the cost and inconvenience of

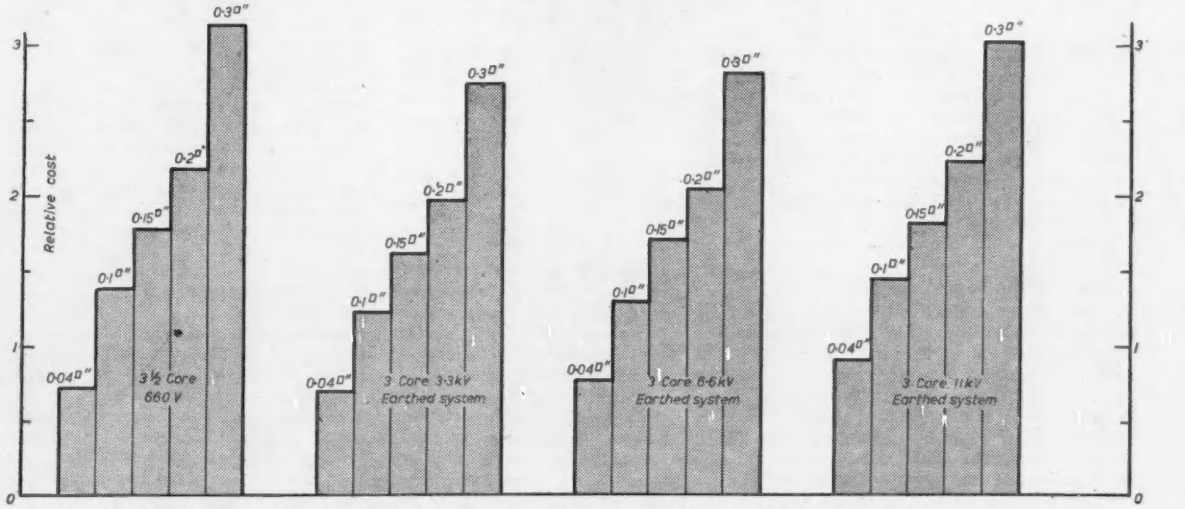


Fig. 1. Relative costs of cables for various distribution voltages showing the predominating effect of cross-sectional area.

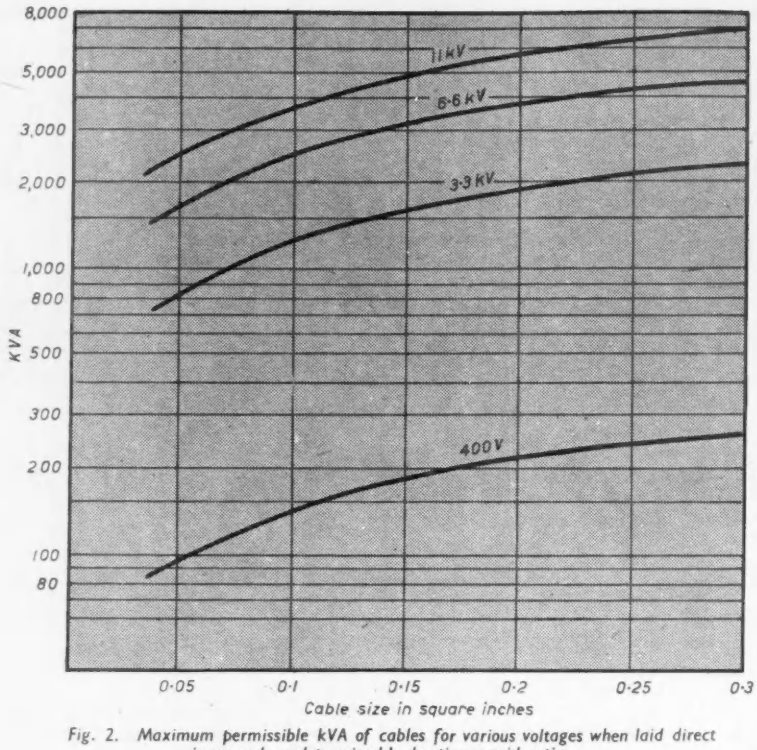


Fig. 2. Maximum permissible kVA of cables for various voltages when laid direct in ground, as determined by heating considerations.

regular painting must be accepted. Wood or concrete poles are much preferable from this viewpoint. Concrete poles are robust and maintenance-free, but involve handling difficulties. Wood poles will require re-impregnation at intervals, but if properly conditioned before installation may have a remarkably long life; there are many wood pole lines in this country which have been in commission for over twenty years.

Atmospheric pollution will also affect overhead line insulators and it may in extreme cases be desirable to insulate a 6·6 kV line, for example, with fittings suitable for 11 kV service. If this is done care should be taken that arcing horns and the like are maintained at their 6·6 kV spacing since otherwise a lightning disturbance may have disastrous effects on switchgear and transformers.

Since cable systems are so much in the preponderance in most works in this country, it is not intended to discuss overhead lines farther, and in all that follows the use of underground cable will be assumed.

Choice of Voltage

When the total factory load is comparatively small, less than 2,000–3,000 kVA, the question of choice of voltage hardly arises, since it will in most cases be found that the most economical arrangement will result if power is taken from the supply authority at low voltage; the layout adopted will depend on the arrangement of the supply authority's network and the incoming feeders may themselves be l.v. fed from the nearest substation, or h.v. lines with step-down transformers to feed into the factory's main l.v. switchgear. In any event, the whole of the works distribution will be l.v. and the problems presented are less complex than those outlined below.

If larger loads are to be met, or if power must be distributed over appreciable distances, an internal factory network at 3·3 kV, 6·6 kV, 11 kV, or even higher with step-down transformers at the load centres may prove more attractive than a "straight" 400/440 V system. To transmit a given amount of power, the higher the voltage, the smaller the cross sectional area of copper required, and, within limits, the lower the cost of the cable. At first sight it might, therefore, appear desirable always to use the highest possible voltage. Yet this is not always the case. Apart from the costs of plant and switchgear, which will be considered later, what factors are to be considered in deciding on the voltage to be adopted?

Allowance for Extensions

Kelvin's laws will show the most economical voltage or the most economical conductor size to transmit a given amount of power at a given load factor. In practice so many other factors have a bearing on the problem that the opportunities for applying Kelvin's laws are few and far between. If a new system is to be laid out and the magnitudes and geographical locations of the loads to be met are known, the points to be considered before deciding on the working voltage and cable sizes are the possibilities of future growth of load and the amount of load, if any, which may be fed at 3·3 kV or higher voltages.

The first point can generally be settled without difficulty, so far as short-term planning is concerned. If large and extensive networks are involved, however, the long-term view is of importance, and here only the judgment of the works engineer can assist in the decision; the possibilities of extensions to the factory site, re-motoring of existing plant or the introduction of new processes must be borne in mind. No hard and fast rules can be laid down, but it should be remembered that there is a definite economical limit to the number of kVA-miles which can be transmitted at a given voltage. Very heavy copper sections may have to be laid to meet loads which have been added to a system whose working voltage has originally been set at too low a value.

If there is any doubt in the matter it is generally preferable to adopt initially a higher voltage system with fairly small section conductors, since even if some of these have to be reinforced at a later date to meet unforeseen increases in load the cost will still be less than that of excessively large cables at a lower voltage. Fig. 1 shows that the cost of cable is largely determined by the cross-sectional area, the additional insulation for higher voltages having only a small effect.

Load Fed at H.V.

It is often possible to feed a certain amount of load directly at high voltage, thus reducing the capital and running charges which would be involved in transformation, l.v. switchgear and l.v. cablework. A.C./D.C. conversion plant nearly always includes a transformer, and if d.c. is required in a works the cost of the conversion plant will not be materially affected by the supply voltage on the a.c. side; such plant is, therefore, connected directly to the h.v. network.

The other class of load which is commonly fed directly at voltages higher than the standard 400/440 V, is that of large a.c. machines. Here again it is not possible to lay down a definite line of demarcation above which a machine can be economically supplied at 3·3 kV or above; it can, however, be stated that 400 V motors of 100 h.p. or less will nearly always prove a cheaper proposition than h.v. machines. If the motor is being added to an existing system, sizes very much larger than 100 h.p. may be found to be more economical at 400 V, depending on the location and size of the h.v. and l.v. mains; each case must be considered on its merits.

It should be noted that for a motor of given h.p. the stator conductors are smaller the higher the voltage of the machine, and this tends to reduce the mechanical strength of the overhang part of the winding. The ability of the winding to withstand the stresses which may be imposed under fault conditions may thus also be reduced and a winding fault which may in itself be comparatively minor may result in the wreckage of a

machine. It is for this reason that whilst, for example, a 150 h.p. motor would be perfectly satisfactory at 3·3 kV, this size would not be manufactured for 11 kV service. Many engineers have, in the past, viewed 11 kV machines with disfavour and in some cases such machines have been rewound for lower voltages. The short circuit level of the system to which the motors are connected obviously has an important effect, and some of the troubles experienced have undoubtedly been due to lack of appreciation of this point.

Should the factory utilise a number of motors of about the size quoted, three possible supply arrangements may be considered:

(1) A 3·3 kV network feeding the larger machines, with 3·3/0·4 kV transformation for the remainder of the plant.

(2) A higher voltage network, e.g. 11 kV, with 11/0·4 kV transformation and all the load fed at 400 V.

(3) An 11 kV network with 11/3·3 kV transformation for the larger machines and 11/0·4 kV transformation for the remainder of the plant.

Examples of each of the above systems are to be found throughout industry, and again each case must be judged on its own merits. When very large motors, of the order of 1,000 h.p. or greater, are in use, practically any voltage can be specified with confidence.

Cable Sizes and Limitations

In urban supply networks it is generally found uneconomical to plan an l.v. system which uses cable sizes above 0·2 sq in. in any quantity, the solution adopted being to transmit power at a higher voltage to a new point of transformation, from which distribution is effected over smaller section conductors. In factories, where there may be a much greater concentration of load, this criterion will not necessarily apply; nevertheless if it is found that a works system is to use appreciable lengths of heavy cable, it is always worth while investigating the economics of a higher voltage transmission system.

The obvious limitation to the amount of power that can be transmitted by a cable is that imposed by the heating of the conductor, and Fig. 2 shows the maximum kVA on this basis for different cable sizes and voltages. Equally obvious is the fact that if power is being transmitted over a long distance, the voltage drop may be excessive. Fig. 3 shows the maximum kVA miles which may be transmitted to give 5% volt drop at the receiving end. So far as the supply authority is concerned the statutory regulation lays down that the voltage shall not vary by more than 6% from the declared pressure at the consumer's terminals, which in this case will be the incoming switches to the factory busbars. The maximum drop permissible within the factory will depend on what voltage-sensitive devices, including lighting, are in use, and generally voltage drops of more than 5% should be avoided. Figs. 2 and 3 may be used together to determine the minimum conductor size for any particular loading condition.

A point which is sometimes overlooked is that the currents which will flow in the event of a fault may be so large that the cable feeding into the fault may be damaged by overheating before the switch has opened, even with the short clearance times possible with modern protective gear. Definite minimum, inverse time relays usually have a definite minimum operating time of 0·2 second to which must be added the clearance time of the circuit breaker. Fig. 4 shows the maximum fault MVA which can be carried for a period of 0·2 second for various cable sizes and voltages. Thus whilst a 0·04 sq in. 3·3 kV cable is suitable for a load of 700 kVA to be fed over a distance of 300 yds, such a cable could not be used on a system with a fault level of 100 MVA. It should be noted that this limitation will not apply to circuits protected by h.r.c. fuses, which apart from having a very quick clearance time actually interrupt the current before it has reached the full prospective short circuit value.

Referring again to Fig. 4 it should be remembered that the fault levels determined by calculation will err on the pessimistic side since the resistance of the circuits is usually neglected and sub-transient reactance values are used for machines, which gives fault currents for the first few cycles only. A useful figure to remember is that cables of less than 0·1 sq in. should not be connected to 150 MVA systems at 6·6 kV or 250 MVA systems at 11 kV.

Types of Cable

With the exception of the smaller l.v. feeders nearly all works power is transmitted via paper-insulated cables with lead alloy or aluminium sheaths; the sheathing may be left plain, served, wire armoured or tape armoured according to the service of the cable.

Steel tape armoured cable is generally confined to installations laid direct in the ground, whilst wire armouring, though

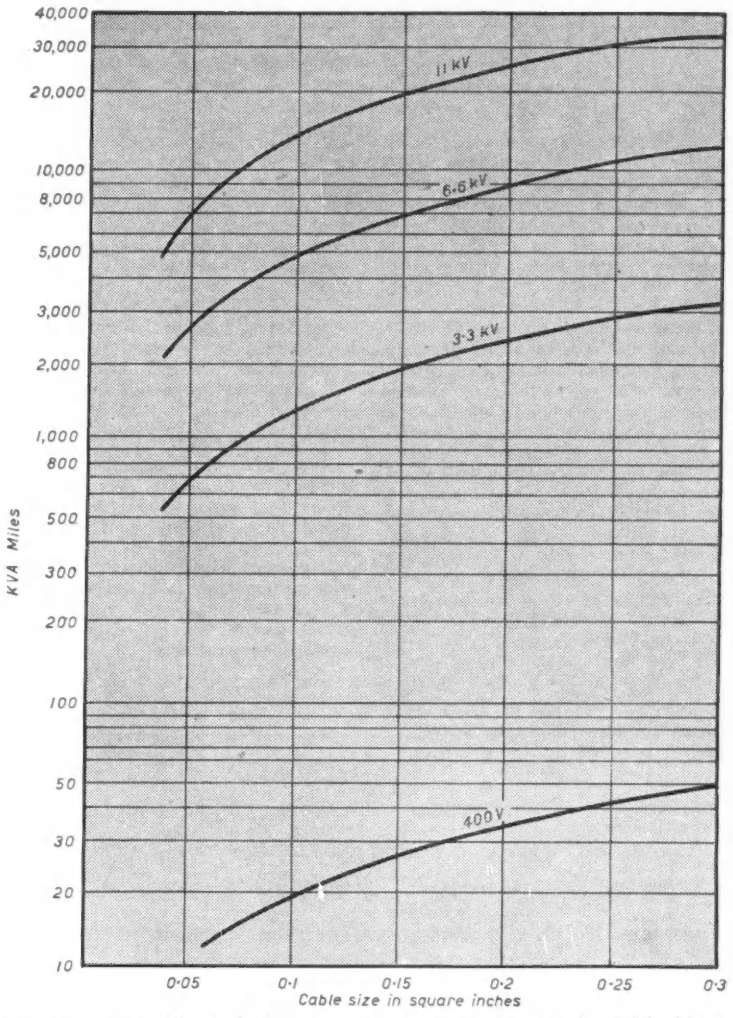


Fig. 3. Curves giving kVA miles for 5 per cent voltage drop at the receiving end, with 0·9 p.f. load using cables of various voltages. In general greater drops should be avoided

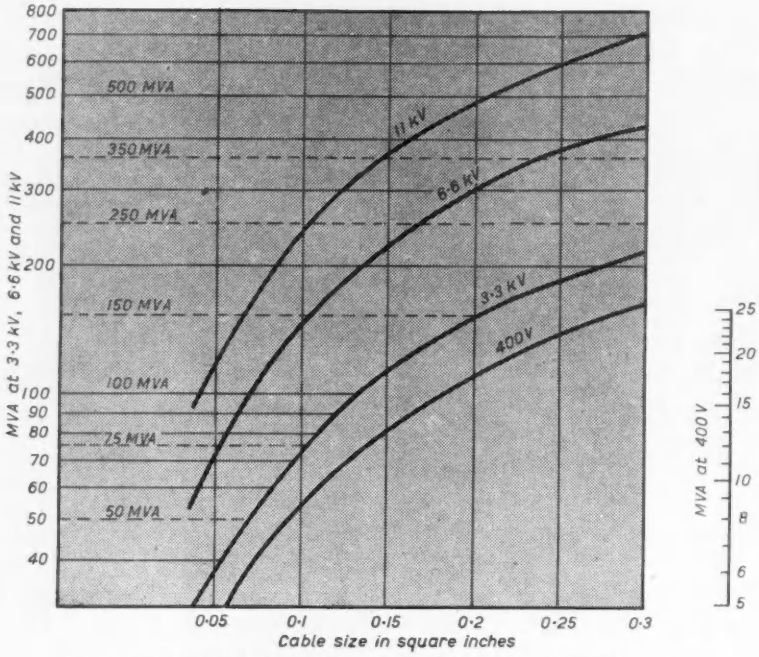


Fig. 4. Maximum MVA that can be carried for 0·2 seconds on cables for various voltages, as determined by heating considerations.

offering less protection to an underground cable, makes a more flexible construction which is suitable for underground or above ground use. The provision of serving over the armouring involves very little extra expense and affords an extra protection for the cable. Cables which are to be laid directly in the ground should always be served to minimise corrosion of the sheath or armouring.

Plain lead covered cables are, of course, cheaper than their armoured equivalents but even when served they require careful handling over long runs to avoid damage during installation; an inexperienced or careless cable gang can very easily wipe out the savings obtained from the omission of armouring by incurring the costs of repairs to damaged lead sheaths. In the author's opinion, plain lead sheathed cables should be avoided unless the alternative is unacceptable, e.g. when single core cables are run as transformer secondaries; here steel wire armouring would be heated by eddy currents and plain lead sheaths must be used.

The cost of terminating paper-insulated cables is appreciable and when very short runs are involved v.r. insulation is sometimes used because of the quicker and cheaper terminations which can be made. For industrial use the finish may be lead sheathing with or without armouring, or serving over which armour wires are laid directly. The use of v.i.r.s.w.a. cable is attractive financially but there are definite limitations to its use; the absence of lead sheathing makes it unsuitable for underground work, and a risk is taken if there is any possibility of contact with oil, which after attacking the serving will penetrate the cores and destroy the insulation.

The shortest distance between two points is a straight line, but it does not follow that this will also represent the most economical route. Whatever method of laying be adopted, the costs of handling and installation represent a considerable portion of the total cost of a feeder; a very rough and ready approximation is to assume that laying charges will equal the cost of the cable.

The most widely used forms of installation are:

(1) Cable laid in cleats, hangers or racks in specially prepared tunnels.

(2) Cable laid in cleats, hangers or racks fastened to structures.

(3) Cable laid in the ground in prepared ducts.

(4) Cable laid direct in the ground.

The last two methods follow standard practice and call for little comment. Method (1) gives the results most satisfactory to the electrical engineer but will nearly always prove the most expensive. This type of construction is, however, frequently used where a large number of cables can be arranged to follow the same route and a new plant is being planned. Extensions to an existing system may also justify tunnelling if a number of cables have to pass an awkward point e.g. the crossing of a heavily loaded railway track. The obvious advantages are the complete security of the route and the ease with which cables may be added or withdrawn. The cable tunnel is sometimes combined with a ventilating duct; if this is done some form of automatic protection is essential to avoid the disastrous consequences which will follow a minor fire if the flow of air is maintained.

Method (2) is very widely used, and indeed, in factories which are all under one roof all the cablework may be carried on racking above ground level. For routes between buildings the structures carrying gas, steam or water mains can often be conveniently followed. In some plants where the ground is liable to be contaminated by oil or acid it may be justifiable to erect special cable structures above ground level if no other alternative is available to direct laying.

Plain lead-sheathed cables require more support in racking than those which are armoured, and the use of cable tray or racking with hardwood cleats is desirable. Care should be taken in the design of racking to avoid the formation of closed magnetic loops round individual phases, since eddy currents and heating of the steelwork will result. Where served cables are led through pipes it is desirable to provide a separate pipe for each cable; if this is not done the impregnation of the serving will in time stick one cable to another and make it virtually impossible to withdraw one of a group of cables at a later date.

Conclusion

It is hoped that enough has been written to indicate the principles on which a works electrical network can be planned or extended once the characteristics of the load are known. The amount of copper installed is a major factor in deciding the total cost of the system; with the costs of cable and labour charges for its installation at today's high level it is apparent that the expenditure of engineering time in the consideration of alternative schemes of supply is fully justified.

Once the question of system voltages has been settled, switchgear and busbar layouts may be investigated and time devoted to more detailed planning. Later articles will discuss these topics.

(*To be continued*)

Industrial Maintenance is a special section of the "Electrical Times" which will appear monthly in future. The February Number will include a continuation of the series "Planning a Works Distribution System" and the second of our exclusive Data Sheets which provide reference information on industrial electrical equipment. Articles in future issues will also discuss legal and management aspects of installation and maintenance.

G.E.C. Air-Break Rotor Starting Panels

DATA SHEET 1

THESE starters are housed in a steel cabinet with hand wheel control, in the centre of which is a push button. Depression of this push button (P) closes the automatic contactor and energises the motor stator. The handwheel controls the rotor circuit and when it moves to the running position allows press button (P) to be released and the contactor maintained "on." The motor is stopped either by moving the control wheel to the off position or by breaking the remote control circuit. Two sizes are dealt with here, size 2, from 1-10 h.p. and size 3, 12½-30 h.p.

The actual starter panel is of slate behind which is fixed the bank of rotor resistances, connected to give three tappings in each leg of the rotor circuit with all the resistance in circuit in the "off" position.

Mechanically coupled to the rotor spider, actuated by the hand wheel are:

(1) Push button (P) and contacts in the centre to energise the contactor coil only when:

(2) A switch (R) on the left of the panel is closed by the spider being in the "off" position.

(3) A switch (Q) on the right of the panel which is only closed when all the rotor resistance is cut out and so enables the push button (P) to be released.

The contacts on the rotor faceplate together with the control circuit switches P, Q and R are accessible from the front of the panel.

The bottom of the panel carries the main contacts mechanically coupled to an auxiliary contact: the contactors are of two types corresponding to the two sizes of starters—size 2, KCBB and size 3, KDBB (Fig. 3). The sketches show the correct contact setting.

The overload relays are of normal dash pot type and adjustable to 100, 125 and 200% of full load current. The calibration plate is marked for a particular coil only. The coils are removed by unscrewing the dash pots and unscrewing the coil support brackets. The coil is fitted with the leads on the bottom.

Apart from keeping the whole starter clean all bolts and screws should be checked for slackness and moving parts lightly lubricated, taking care to keep oil and grease away from the operating coil, insulation, pole faces and contacts. The rotor segments must be kept clean and the "off" contacts kept level with the segments. A little Vaseline can be used here with advantage.

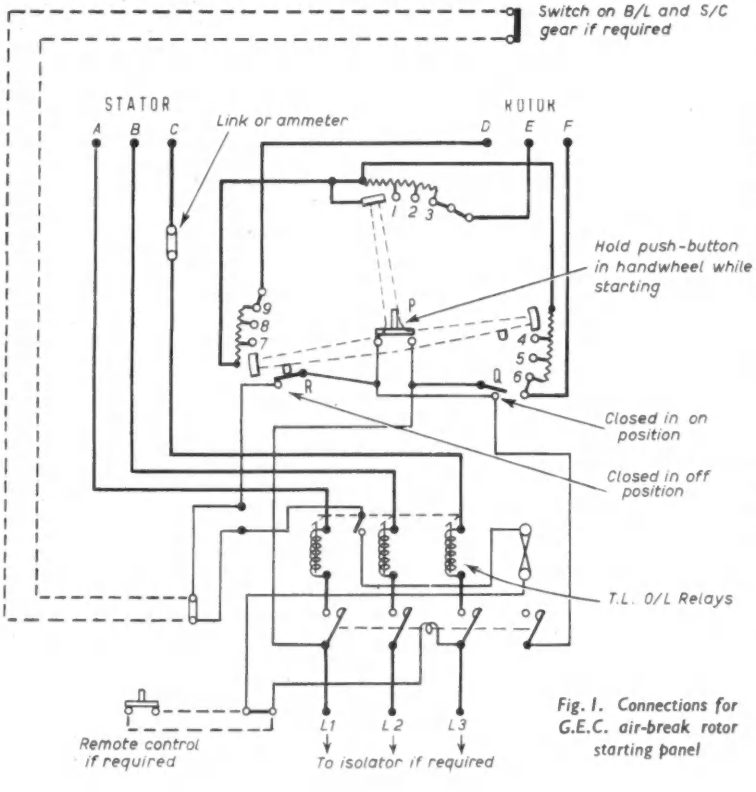


Fig. 1. Connections for G.E.C. air-break rotor starting panel

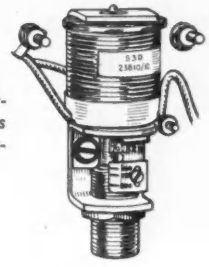


Fig. 2. Magnetic overload relay MBBB as fitted on rotor starting panels

LIST OF SPARE PARTS

	Type 2	Type 3
Rotor Panel		
Fixed contact	S3D 13489-B	3061
Moving contact	2411	2411
Off blocks	S3E 850-B	S3E 850-B
Contactor		
Fixed contact	S3D 1444-A	S3D 1444-B
Moving contact	S3D 5937-A	S3D 14482-A
Spring	12627	10348
Braid	S3D 8105-A	12899
Arc chute	12756	12381
Shading band	D 95895	S3D 8291
Pull off spring	S2D 1389-A	2064
Contactor coil	S3D 11039-A* (110V)	240 S3D 486-A 415 „ -J 500/50 „ -K
Overload Relay		
Fixed contact	12606	
Moving contact	12605	
Spring	12603	
Coil	as stated on label	

*Type 2: 200/50 V—S3D 11039-B; 320/380-D; 400/480-E; 500/550-F

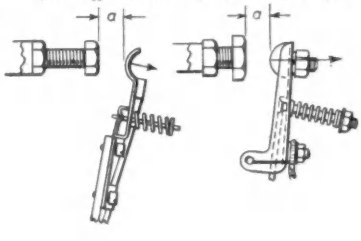
The action of the interlock switches must be checked and the general insulation to earth taken. The contactor itself requires regular inspection. The coil must not be loose, the pole faces must be clean and flat and the shading band in the pole face intact, otherwise noisy operation will result. The air gap across the upper edge of the top pole faces should be:

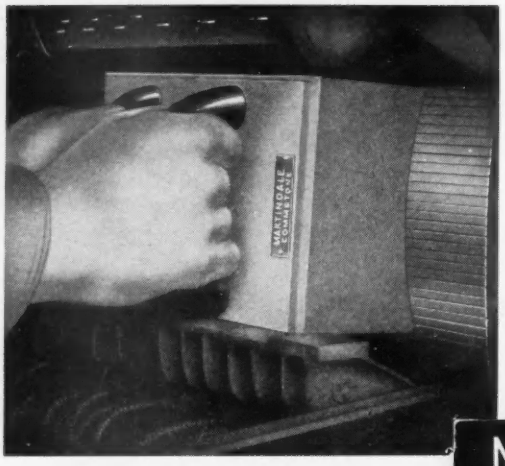
Size 2—15/32 in. Size 3—9/16 in.

The contactor and remote control circuit is protected by a 100 A fuse (38 s.w.g.). The contactor contacts must be checked for wear. It is not advisable to file them to shape; they bed naturally.

The overload relay should be kept filled to a depth of 3/16 in. with Mobiloil Grade A. for normal industrial use.

Fig. 3. Below, left, contact type KCBB, $a = \frac{3}{8}$ in.; contact pressure 7 to 8 oz. Right, contact type KDBB, $a = \frac{7}{16}$ in., contact pressure $1\frac{1}{2}$ to $1\frac{3}{4}$ lb.





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MAINTENANCE in a Light Alloy Foundry

THE BIRMID WORKS OF BIRMINGHAM ALUMINIUM CASTING CO. (1903) LTD.

THE melting of metals usually means production of fumes. That is a general experience in foundries, and when magnesium is being handled, the problem is intensified. Fumes that are apt to be corrosive, abrasive sand, and continuous production are three outstanding difficulties which confront the electrical maintenance staff of Messrs Birmingham Aluminium Casting (1903) Co., Ltd., at their Birmid works in Smethwick.

Production of aluminium alloy castings for a very wide range of industries, with concentration on i.c. engine manufacturers, is the concern of the company. In general, semi-finished castings only are produced, machining being left to the ultimate user; but this still leaves a wide enough range of work to be handled, for apart from the question of different alloys, pressure, gravity and die castings are produced by processes extending from automatic mass production to individual casting in large and intricate moulds.

There are three main works carrying out the production programme that this wide activity implies, and they are spread over a 40 acre site, being known as the Central and East Works and the Magnesium Foundry. A railway line in a cutting divides the site into two, and alongside this there is a producer-gas plant supplying the various foundries. All production buildings are multi-bay single storey structures, and the site is well provided with access roads, which have conventional electric lighting.

Electricity Supply

The Magnesium Foundry, built and maintained for the production of magnesium castings for aeronautical and commercial requirements, is situated near the terminal point of a 132 kV multi-circuit line from Birmingham, and the main intake substation is naturally here. The open-air B.E.A. substation feeds into a directly adjoining Midlands Electricity Board 33 kV substation, which supplies all the factories in the locality.

It is only a hundred yards or so from this M.E.B. substation to the main works substation, and this distance is covered by two 6·6 kV cables. A stand-by supply is provided by a 6·6 kV line from the local Electricity Board network looped into the main substation.

6·6 kV is accepted as the voltage for primary distribution around the works, a ring main being laid to feed five substations, one at the end of a spur. In these substations the voltage is transformed down to 400/230 V, three-phase.

There is a 13 unit h.v. switchboard in the main substation, the 6·6 kV equipment here as elsewhere being by Brush. Six of the switches are owned by the Electricity Board, and remaining seven by Birmal. The 6·6 kV switchboard is provided with high-speed Solkor protection.

It is appropriate to remark here that the 6·6 kV gear in all the substations is maintained by electricity board engineers. This is the only electrical job in the works which is not undertaken by the factory electrical maintenance department.

The 6·6 kV cable is of paper insulated plain lead covered construction, laid direct in the ground. Where it crosses the railway line mentioned above, it is enclosed in a steel pipe which runs on the services rack alongside a road bridge. Aggregate installed transformer capacity in the works is 7·2 MW. At the date of our visit, the maximum demand was 3·4 MVA, 2·95 MW, giving a full load power factor of 0·87.

Electrical Department

To install and maintain the electrical equipment in this large works, there is an electrical staff of 27 under the control of the Works Electrical Engineer. The electricians are divided into three sections (one to each works) each under a foreman. In addition there is an instrument engineer with two mechanics; a telephone mechanic; and an assistant for the works electrical engineer concerned mainly with electronic control gear, which is finding increasing application in the works.

Two men are kept on night shift, there being a relatively small amount of production during this period. Both men are electricians, as this is considered a more economic arrangement in the long run than employing an electrician and mate. They are given routine maintenance and installation work to do during their shift, but are available for any emergency job that may arise.

Pyrometers are the principal concern of the instrument department as temperature measurement and control is, of course, a most important factor in light alloy foundry work. The section makes up its own thermocouples, and in addition to this work is concerned with the calibration and maintenance of some 219 instruments, including pyrometers, thermostats, controllers, recorders and indicators.

The internal telephone system used is of the automatic type, with A.T.E. equipment. At present a 300 line exchange is provided, with rack space for future expansion. A full set of test gear is held by the electrical department, and the manufacturer's engineers are brought in every four years or so to give the plant a general overhaul.

Installation

Before maintenance routines are discussed in any detail, it is convenient to consider the electrical installations in the various works. For this purpose, a start may be made with the Magnesium Foundry, which, it will be recalled, adjoins the main substation, and is fed from there on the medium voltage side. The 400 V oil-filled switchgear used here, is of George Ellison manufacture. There are four 600 kVA Brush transformers standing outside the substation.

In considering the electrical distribution equipment in this section of the works it is necessary to bear in mind that the buildings were erected, and the plant was installed, in the early war-time days, when a rapid increase in production was the prime necessity, and whatever equipment was available had to be pressed into use.

The feeds from the substation each come through a fused isolator into distribution boards at the load centres. Fuses in the boards are of the rewirable type. All cabling is braided v.r.i. The corrosive conditions make the use of steel armouring impracticable. This part of the works is indeed one of the most difficult from the corrosion point of view. Heavy fumes come off from melting pots containing the magnesium alloy, and special techniques have to be adopted for all electrical apparatus. Conditions near the roof are particularly difficult. Some floor-operated cranes are fitted with a direct connection from supply point to crane motors, partly because of corrosive attack on bare lines and slippers, and partly because of the additional safety given when bare conductors, running at low levels, are eliminated. The technique used is to support a t.r.s. cable from "curtain rings" running on a strained catenary wire. Sufficient loops of t.r.s. are provided to reach from the supply end of the crane to the other end of its travel without stretching.

Where this procedure cannot be adopted bare crane wires have a rather limited life, and collectors have to be fitted with a scrubbing device to ensure reasonably good operation.

Lighting is by high-mounted 750 W tungsten lamps, switched in pairs. Here again, difficult conditions have to be over-

Section of the extensive Tool Room showing feeds to machines and benches

come. Reflectors are removed at frequent intervals, sprayed white inside and reinstalled. Only in this way can a reasonable standard of illumination be maintained.

At one end of the long bays comprising this section of the factory is a sand preparation plant. Here the abrasive attack of sand is added to the chemical attack of the metal fumes. An answer is found in the use of totally enclosed squirrel cage motors for all drives. These machines are modified in respect of their terminal boxes, which are removed before the motors are installed, the supply cables being taken straight in to the stator connections. The whole is then strapped up heavily with black tape as a seal. If this were not done, chloride fluxes plus sulphur dioxide condensate would find their way into the terminal box, and in a short time a flash-over would occur at the motor terminals.

The motors are sequence started in this plant. Where it is possible to locate control gear outside the worst area, standard a.c. contactor gear is used, but inside the corrosive zone, George Ellison gear with its oil-immersed contacts is found particularly useful.

There are pits underneath the sand preparation plant, which have to be lit for operational purposes, and in the interests of safety, a 25 V supply is provided. Several step-down transformers are installed for this purpose. Bare bulbs are used with Edison Screw Caps. These have many advantages over bulkhead fittings for this application. They are more easily cleaned, for instance, while their non-standard voltage and caps discourage unauthorised removal to other sites.

Producer Gas Plant

A substation with a single 600 kVA transformer supplies the three producer gas plants. The plants are completely exposed to the weather, and motors and control boards have to stand up to these conditions. The control equipment is, of course, enclosed in heavy steel boxes, from which run lead covered and armoured cables. These pass through underground ducting and emerge directly under the motors they are supplying.

All motors on the gas producer plants are equipped with ammeters, and these provide not only a check on the loading of the machines themselves, but also an indication of the functioning of the gas plant.

East Works

The arrangement of distribution in the East Works is in marked distinction from that so far described. The 400 V side of the substation is equipped with English Electric fusegear, incorporating category 4 h.r.c. fuses. The 400 V switchboard is divided into four sections, each corresponding to one of the transformers; actually the load is such that one of the transformers is a spare. The buscouplers in the run of fuseboards are provided with pole operated isolators.

Each of the fuse units on the 400 V board has its own off-load switch, and is provided with an ammeter on each phase. Voltmeters and selector switches are also installed. All fuses throughout are of 500 amp rating. A systematic scheme of labelling is applied, whereby each board carries in large letters the designation of the transformer from which it is normally fed, the circuit going out from it, and the destination of that circuit. This system is continued further down in the distribution scheme on distribution boards, etc.

All cables from the substation to main shop fuseboards are 0·25 sq in. p.i.l.c.s.w.a. From the boards subsidiary cables are run in 0·04 sq in. cable. These shop boards are again provided with h.r.c. fuses, the standard arrangement for the main boards being six 100 amp 3-phase ways. The discrimination between the various fuse ratings has so far proved fully satisfactory, and no main fuse has yet blown.

The shops in this section of the works consist of several bays each 700 ft long. Main cables are run along racks under the crane rail, and they then peel-off one by one to the various fuse boards. These are duly marked with a number corresponding to the substation feed. At the end of the bay there is again a sand preparation plant, and the use of totally enclosed motors and low voltage lighting is repeated.

Lighting in the East Works shops is mainly by mercury vapour discharge lamps. Trouble again occurs due to corrosion, and from time to time chokes burn out. They are then shorted out, and a tungsten lamp is substituted for the mercury vapour unit, until an opportunity occurs for attention to the faulty choke. Heat treatment is necessary for the products of this section of the works, and in this connection there are eight electrically heated furnaces installed. The ratings range from 60 to 200 kW, and the maximum demand from this load is 740 kW.

In the compressor house feeding this section, there are two 140 h.p. wound rotor induction motors driving low-pressure blowers, two 122 h.p. driving compressors, and four smaller compressor units rated at about 70 h.p. each. These are all fed through English Electric fuseboards with main isolators, and all starter gear is by George Ellison. Similar conditions obtain in the Magnesium Foundry and Central Works compressor houses.

Central Works

The 400 V switchboard in the Central substation is provided with George Ellison oil filled gear. It is notable in that energy meters are provided on each outgoing circuit for internal accounting purposes. This practice will eventually be extended to all substations.

Amongst the sections fed from this substation is the machine shop which is operated for the plant department. In this, wall mounted fuseboards feed individual machines through v.r.i. run in conduit sunk under the floor screeding. Low voltage lighting is provided where necessary on all machines.

Maintenance

This, then, is the pattern against which the electrical maintenance system operates. Before it is considered in detail, however, the maintenance factors that have been born in mind in planning the installation may be recalled. First of all comes protection against dust and fumes. In general, the answer is enclosure. T.E. motors seem free from trouble even in the most difficult situations and t.r.s. cables in substitution for bare copper prolong the life of crane wires. In certain places where rubber may be attacked, p.v.c. cables are used. Then there is care that no electrical equipment is loaded up to its nominal rating. Under-running is the order of the day in the plant where continuity of operation is of first importance. The advantages of this policy are immediately apparent in the substations, where the relatively low oil temperatures ensure that there is little trouble with the oil-filled switchgear. Similarly, when this practice is combined with careful setting of motor protection,

burnouts are found to be very rare occurrences.

Single-phasing is a problem in many works, but little trouble of this nature has been experienced at the Birmid factory. Apart from the under-running policy just mentioned, there is a practice of fitting overload trips on all three phases except for the smallest motors. Full advantage can be taken of this protection, because the conservative loading of the motors means that the trips can be set without too much allowance for starting currents. Most motors are protected locally by rewirable type fuses, with back-up h.r.c. fuses providing short-circuit protection.

All important motors are provided with ammeters. These give a useful indication of the loading of the motor, and also provide information for the operating staff about the driven plant, especially where fans or pumps are concerned.

Apart from the standard motor control gear used on the larger motors, there is a considerable amount of specially built gear which is used in sections of the factory where automatic machinery is working. The practice is for this equipment to be designed by the electrical department, and then built by a firm of specialists (Contactor Switchgear Ltd.).

This is another instance where the principle of under-running is applied. The reason here is the severe vibration to which the contactors are subjected and the time for which they are expected to run in between service visits. Several 3-phase contactors are mounted on a panel in most of the controllers, and they operate many times an hour—often many times a minute. The consequent vibration is very severe, and down rating is desirable to ensure reasonable life for the contacts concerned.

Inevitably, the operation of automatic machinery entails the use of a number of limit switches. Care is taken that these have large contacts, and that they are suitable for use in any position. They are made watertight, but capable of easy inspection, and above all, really robust so that they can stand up to the hard knocks they may receive during mechanical maintenance of the machine to which they are fitted. A spring return design is preferred and special attention is given to securing a spring that is very resistant to fatigue.

Where possible, the micro-break principle is used for limit switches, but care has to be taken to avoid inductive loads. Where they are met and a micro-break type limit switch is in operation, a resistance is put across the load to ease the operating conditions

Substations

As was mentioned earlier, all 6·6 kV equipment is maintained by the Midlands Electricity Board. Where oil-filled 400 gear is used in substations it is given a yearly maintenance inspection, though usually the only work found necessary is the polishing of the contacts. Oil is changed about once in every four years.

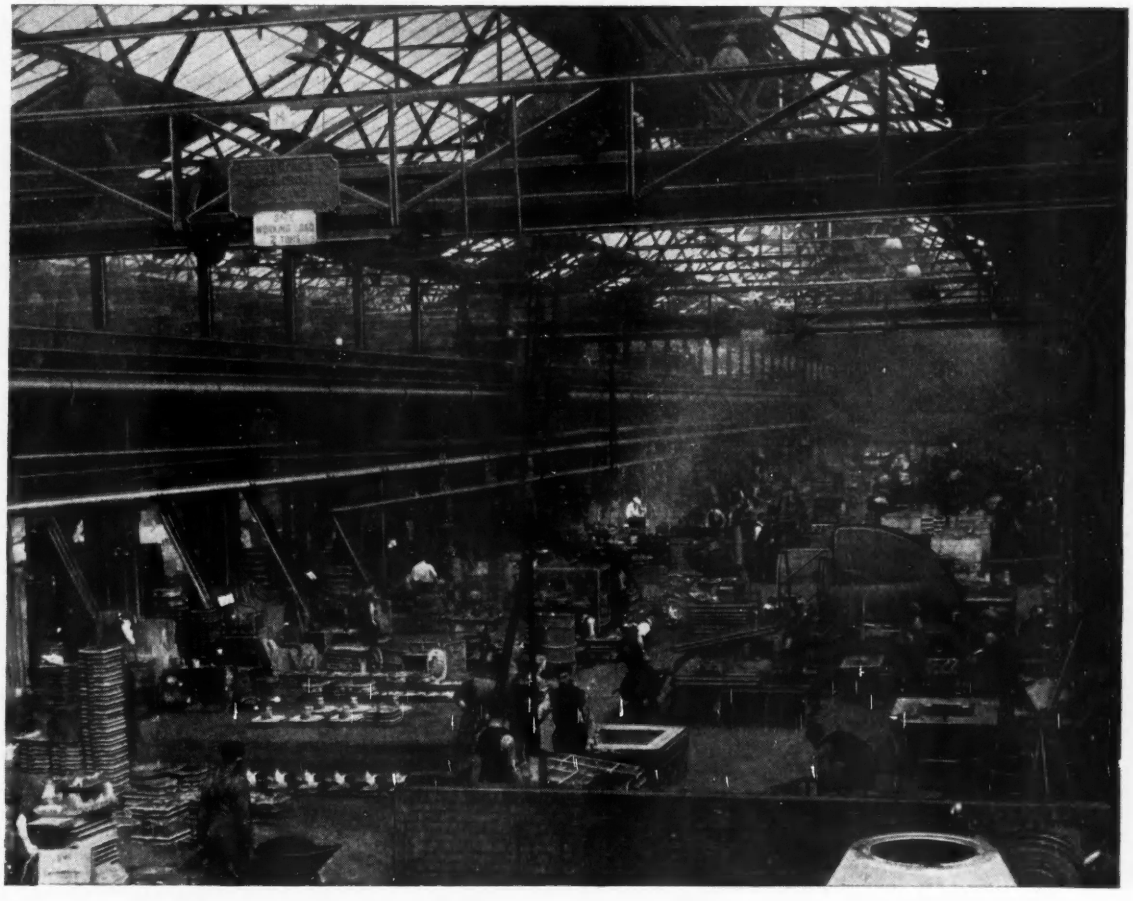
Motors

Something over 1,000 motors have to be cared for by the electrical department, almost all of them squirrel cage induction machines. Since it is a principle of the department to keep paper work to a minimum, there is no comprehensive card index of motor histories. Instead, each motor is indexed in a frequently revised register, against the machine which it is driving.

Routine inspection of the motors is carried out by one man on continuous patrol. He checks such symptoms of possible trouble as bearing noise, excessive temperatures, and laboured running, and reports to the responsible foreman. This patrol man is also responsible for keeping bearings greased and the motors reasonably clean externally.

Apart from any emergency action taken as a result of patrol reports, all motors

General view of one of the main shops showing the general conditions encountered where sand casting is undertaken



are inspected periodically if they are working in a dirty situation, and as frequently as once every two months if they are exposed to metal swarf. Cleaning and blowing-out is all the treatment that is usually required.

When attention is necessary to the motors on the gas producer plants, dismantling is carried out in the open. However, this is seldom needed, and, in fact, only twice in the years has emergency action been necessary. There is usually one of the gas plants out of operation at any given time, and advantage can be taken of this for any necessary routine examinations. The gas plants are an example of light loading paying off dividends in terms of freedom from electrical troubles.

From the remarks that have been made, it will be apparent that there is not sufficient work to justify the employment of an armature winder. Any rewinding is carried out by a local firm which gives priority attention.

Control Gear

Contactors on motor starting and control gear are inspected periodically, the work being fitted in at week-ends. Ellison oil-filled gear is the general choice in dirty situations, with Crabtree or Donovan contactors elsewhere. Frequent attention is given to crane controllers with the accent on checking contact spring tension.

For the electronic control gear used on automatic machines, special test sets are built. These simulate the actions of the machine with which the controller is usually working, so far as operation of sequence switches and interlocks are concerned. Thus a thorough check of a full operating cycle, and of all safety features is possible without the need to have the machine operating. Push buttons are provided to duplicate those on the machine, while limit switches are represented by finger operated keys.

Facilities are provided on all automatic controllers for plugging in the test set, while the controller is still in place on its machine. When this is done, the supply is automatically disconnected from all the machine driving motors.

Although this "on the job" test facility is provided, the usual procedure in the event of trouble on one of these automatic controllers is to plug in a complete spare and then remove the faulty panel to the workshop for inspection and repair. The change-over can be carried out in a minute or so, and interference with production thus minimised.

Contacts cause occasional trouble in the controllers due to the severe vibration to which they are exposed in their frequent operation. As a routine measure, attention is given to these points when the controllers are taken out of service for a once monthly overhaul. Electronic tubes in general have a long life, and since they are easy to replace, present no special maintenance difficulties.

Limit switches associated with automatic machines are inspected at least weekly. Special attention is given on these occasions to the tension of return springs.

Portable Tools and Lighting

Electrically operated portable tools are always taken from stores by an electrician. When they are issued, attention is paid to the condition of the flexible lead, and the tools are afterwards connected up by the electrician, usually to a distribution board, before being handed over for use by non-electrical personnel. Every so often, portable tools are called in for workshop maintenance. Apart from being cleaned, and greased, they are then disconnected from their flexible leads. A foot is cut from each end of the lead, and it is then reconnected to the tool and plugs.

Considerable attention has to be given to the lighting installation both on account of the difficult conditions that have already been mentioned, and also because of the changing needs of production. In this latter respect it has to be remembered that although the general run of foundry work can be carried out with quite a low level of illumination, there are many intricate jobs which require a considerably higher level of lighting. These jobs may come on any part of the shop floor, and the general practice is to rig up temporary lighting to accommodate them.

Lamp replacement in general can occur either when a lamp fails or when a drop in illumination is noticeable. There is no planned replacement system based on lamp life. Frequent repainting of reflectors in the parts of the works where corrosive conditions exist is necessary, as has already been mentioned. Electricians are now used for all lamp work.

Earthing and Power Factor

Two technical points of some importance require attention before this account is completed; earthing and power factor. One earth serves each section of the factory, taking the form of a cast iron electrode 8 in. diameter, 10 ft long and buried in coke. For earth continuity, reliance is placed on metal conduit and on cable sheathing.

On the question of power factor, it is of interest to note that the possibility of installing static capacitors has been considered several times, but the decision has just gone against them. This may seem surprising when there is a fairly heavy motor loading, especially in the compressor house, and the works are charged on a monthly maximum demand tariff. However, factors that alleviate the effect of lagging loads are the heavy lighting demands and the 740 kW of unity power factor load provided by the resistance furnaces. These account for the not unreasonable power factor of 0·87 at peak load.

None the less, there would probably have been a case for installing some kind of synchronous motor in the compressor house if these had been equipped in normal times. However, wartime conditions made synchronous machines very hard to come by, and their inevitably greater length would have caused some difficulty in a closely built factory.

Training

One feature of special interest is the close attention given to the possible advantages of electronic apparatus. At present this is used on a relatively small scale except in the form of timing circuits for automatic controllers, and they are not considered in our description but already certain special problems are growing up. To quote Mr Walker, the Electrical Engineer at the works: "It is difficult, if not impossible, to obtain men who are good on electrical maintenance and at the same time have a working knowledge of electronics. As one job can combine both these aspects of electrical engineering it is a great asset to have men who can go down to a job and sort out trouble, whether it is electric or electronic, and such men usually have to be trained inside your own works."

Our thanks are due to the Birmingham Aluminium Casting (1903) Co., Ltd., to Mr W. Rose, the Chief Engineer, and to Mr M. Walker, the Works Electrical Engineer, for permission to publish this article and for help in preparing it.

Conveyor and machine arrangements in a pressure die casting bay are seen here

Some Points about the Electricity Regulations

by H. W. SWANN, O.B.E., D.F.H., M.I.E.E.

SOON after the Electricity Regulations were first published in 1908 it was recognised officially that they needed a good deal of explanation but I do not think anyone realised at that time how long it would take. The job of explaining has really been continuous ever since, that is for 46 years, because as the regulations have remained pretty much in their original general form their "explanation" has had to try to keep pace with the change of practice resulting from the rapid expansion of electric supply and utilisation. Having tried myself now and then, I can say that it has not always been easy to explain to the manager of a factory the requirements of a regulation which was written well before some new electrical process he is operating was known. It is perhaps a little surprising that the position is generally accepted, but most managers, workpeople and inspectors are all aiming at the same objective—electrical safety—and their differences are usually on the method of achieving it rather than on the age of the regulation by which it is required.

The application of the regulations to the Electric Supply Industry in particular has however undergone some change by reason of the 1937 Act. It rests on Section 103 which was intended to extend the coverage in the interests of the supply workpeople but it has been attended by some uncertainty mainly due to the terms in which the clauses comprised in S.103 have been written. The original policy in mind, so far as I know it, was to cover electrical stations which by reason of their size, and purpose resembled factories employing workpeople to make something to sell.

ELECTRICAL STATIONS AS DEFINED IN PART 1 (20) OF SCHEDULE VI FACTORY AND WORKSHOP ACT, 1901.

> "Electrical Stations" that is to say, any premises or that part of any premises in which electrical energy is generated or transformed for the purpose of supply by way of trade, or for the lighting of any street, public place, or public building, or of any hotel or of any railway, mine, or other industrial undertaking.

The law officers of 1901 seemed to have hit this off neatly enough by a single definition of an electrical station in the Act of that year (Part 1 (20) Schedule VI) but at the beginning of Swinburne Inquiry on 3 Mar., 1908, it was strongly pressed that the factory regulations proposed should not apply to electricity undertakings already subject to the Regulations of the Board of Trade made under Section 6 of the Electric Lighting Act of 1882. It was pointed out, however, by the Board of Trade, that their powers were confined to measures intended to secure the safety of the public, and Swinburne took the view that they did not seem generally to be designed to secure the safety of the workmen, and he advised that the latter should be covered by the factory regulations, a course to which the objectors finally agreed.

What are Premises ?

When these regulations were presently issued on 23 Dec., 1908, they probably protected the majority of the persons employed in electric supply who were then mostly working in the little power stations and substations of the day around which the definitions of "electrical stations" had been written. It is however plain from the use of the term "premises" in the definition, that something substantial was implied, thus maintaining the conception of resemblance to a manufacturing concern.

I do not think the term "premises" has been exactly defined in law and when supply extensions into the countryside brought enquiries as to the application of the Act to pole transformers and such like, I tried to get a line on the meaning of the term in other connections. We had obviously used it to prevent the tentacles of the Act stretching out too far and it occurred to me therefore that if I went to the local rating authorities and their surveyors I might find the same term used but under the opposite kind of urge. I found they had bracketed it with others of which the favourite was "hereditament" an impressive word likely to inspire confidence in the justice of assessment for rates. I heard also of a case in which a bookmaker standing on an upturned barrel to call the odds, contended in Court that he was doing business on his own "premises" but he failed to gain the support of the Bench.

Mr Scott Ram thought the term "premises" a little vague by itself and thus when he defined substations in the first draft of the regulations he added the condition that they must be large enough to enter (after the apparatus is in position). When much later the original statutory definition of "electrical stations" of 1901 was revised for the 1937 Act Ram's words about entry were imported into Section 103 (2), and I am referring to this later in the article. This queer way of drawing the line, does of course lead to some degree of uncertainty which on some occasions is not without its amusing side.

ELECTRICAL SUBSTATIONS AS DEFINED IN ELECTRICITY REGULATIONS, 1908.

> "Substation" means any premises, or that part of any premises, in which electrical energy is transformed or converted to or from pressure above medium pressure, except for the purpose of working instruments, relays, or similar auxiliary apparatus; if such premises or part of premises are large enough for a person to enter after the apparatus is in position.

Readers may wish to consider the situations they deem to be subject to regulations and compare them with those which are not. A person may be able to get into a kiosk housing a small transformer but when the rising demand leads to the installation of a larger unit the place may cease to be an "electrical station" to a fat man although a thin one must obey the law.

In actual practice, however, this absurdity has never been a matter of much moment because the large organisations which run the electric supply industry in this country would hardly care to take advantage of such fine points in view of their responsibilities to their workpeople. This, however, is not to say that their legal advisers would overlook them if it came to defending a case in Court, but in my recollection the issue has not been raised in such circumstances. Some uneasiness did however develop in the workpeople's organisations in the early thirties, and it led to an instruction from my administration to ascertain the position at that time and to estimate the extent to which persons employed in electric supply undertakings were protected by the Factory Act.

Protection by the Act

I had no factual information on the subject, and embarked on a round of visits to supply undertakings where, as usual, I received every assistance. Pay sheets were examined to ascertain the numbers employed in the various categories and, so far as I remember the results, they showed that the majority of persons employed were engaged in some form of distribution work during which they were protected only when working under a roof. This I know is an oversimplification because the position varied widely as between metropolitan and provincial undertakings, but the survey indicated that considerable changes had occurred since 1908 and the coverage then intended was no longer achieved. I remember discussing the matter with Mr

Mr Swann, who was latterly H.M. Senior Inspector of Factories and Electrical Adviser to the Home Office (and is now Director, Chilton Electric Products Ltd.) writes here about the Electricity (Factories Act) Special Regulations 1908 *and* 1944.

Deakin, who was concerned about the position of linesmen, jointers and the other travelling grades, and in the event he with other representatives of the men's organisations attended a meeting at the Home Office at which the Parliamentary Under Secretary presided.

There was not much evidence of accidents amongst the unprotected grades but I think the impression left in the official mind was that something ought to be done to restore the original measure of protection, although nobody had a clear idea of how to set about it. It was realised that the Electricity Regulations as they stood were not suitable for, say, linesman's work, and anyway their extension to such work meant taking new basic powers under factory legislation which would lead the Department into an unroofed and ill-defined field to which it was unaccustomed. A new Factories Bill was being planned, although it did not in fact materialise until 1937, and the matter was included for later consideration in that connection.

This meeting, with a good many subsequent internal consultations, did however lead to a considerable extension of scope in the Factories Act, 1937, which increased the coverage, although not to the extent of protecting linesmen perched on pole tops or travelling grades, except when the latter were engaged on work in premises to which the new Act applied. It was realised that the old conception of eight hour shifts in substations housing rotary converters and such like plant, had largely given place to transformer and switching stations attended only on occasion by visiting staff but it was considered that factory legislation could not go further than an endeavour to ensure their safety when so engaged.

Accident Rates

This may perhaps be characterised as a half measure, but I think it goes further than half-way. I possess no detailed information as to the circumstances which attend accidents to linesmen although I have for some years collected figures which show the number of electrical fatalities per annum from all causes under either industrial or domestic conditions. In 1950 for instance, there was a total of 124 fatal electrical accidents of which 13 occurred on overhead lines, some I believe to members of the public as distinct from linesmen. Cable jointers do not figure in the list and it is seldom that a fatality happens at pole transformers or small transformers with associated control gear, standing in open country.

In the absence of statutory regulations designed specially for this class of outdoor work much importance attaches to the carefully prepared rules of the British Electricity Authority and to the work of their safety officers some of whom were previously employed for many years in the electrical branch of the Factory Department. Every accident is investigated, wherever it occurs, and as both the Central Authority and the Area Boards are under a statutory obligation to report them to the Ministry of Fuel and Power it may be concluded that the present day position is not altogether unsatisfactory.

ELECTRICAL STATIONS AS DEFINED IN SECTION 103 (1) FACTORIES ACT, 1937.

> The provisions of this Act shall apply to any premises in which persons are regularly employed in or in connection with the processes or operations of generating, transforming or converting, or of switching, controlling or otherwise regulating, electrical energy for supply by way of trade, or for supply for the purposes of any transport undertaking or other industrial or commercial undertaking or of any public building or public institution, or for supply to streets or other public places, as if the premises were a factory and the employer of any person employed in the premises in or in connection with any such process or operation were the occupier of a factory.

The new electrical section (No. 103) which appeared in the Factories Act 1937 was a good deal longer than that of the 1901 Act. There are six sub-sections of which the first puts the generating stations on the same footing as a manufacturing concern. It was thought unnecessary however to apply the whole of the Act to transforming, switching, or converting stations—for instance, the provisions about steam boilers or overcrowding which appear in Part 1—and therefore sub-section (2) gives a let-up.

ELECTRICAL STATIONS: FREE EXTRACT FROM SECTION 103 (2) FACTORIES ACT, 1937.

> The provisions of this Act hereinafter mentioned shall apply to any other premises large enough to admit the entrance of a person after the machinery or plant is in position.

It does however copy from the definition of substation in the regulations the idea of making size the criterion of application, and if a person can manage to get in he may be fairly sure he is enjoying such protection as the law affords. If however there is no room inside and he opens various doors and does a job or two from outside, standing say on wet ground in the rain, I am not quite sure about the legal position, for sub-section (2) says nothing about partial entrance. Should there be an outer fence within which he is working the whole area thus enclosed is probably under the Act, but I think it would be difficult for a Court to find that a man going up a ladder to a pole transformer in the countryside is on factory premises of any kind. These points are, however, more of academic interest than of practical importance unless, as I said earlier, there is some question of legal proceedings.

ELECTRICAL STATIONS: FREE EXTRACT FROM SECTION 103 (3) FACTORIES ACT, 1937.

> The Secretary of State may by special regulations apply sub-section (2) to any machinery or plant used elsewhere than in the premises mentioned in that substation or in sub-section (1).

Sub-section (3) leads me back again to the time when the administrative officers of my Department were considering what to do after meeting Mr Deakin and others. I had put forward the suggestion that we might copy the simple methods of the Electricity (Supply) Acts 1882 to 1936, which applied the Electricity Supply Regulations for securing the safety of the public to all undertakers and their "works" without reference to "premises" size or entry. I thought that, following Swinburne's original recommendation, there should be two parallel codes of regulations for electric supply, resting on the same sort of statutory basis, and dealing respectively with safety of the public as distinct from that of persons employed. I discussed it more than once with the late Sir John Brook, then deputy chairman of the Electricity Commission, and he gave me some support suggesting also that we might get the Stationery Office to bind up the two codes together under one cover. He came over to the Home Office on one occasion to talk to my people but the latter were a shade stolid and in the event the idea was dropped with Sir John's untimely death.

Sub-section (3) was, however, put in, as a reserve for future contingencies and if the powers acquired under this clause were ever exercised the factory regulations could be extended without restriction as to size of premises and entry to any machinery or plant used by the supply industry. Read in conjunction with the preceding sub-section this could have the effect of applying the factory regulations to most "works" of an undertaker except lines and cables but by a somewhat tortuous path which might be justified by future experience of accidents or some new departure in supply practice. There is no present likelihood of the Special Regulations which would implement this sub-section being made.

ELECTRICAL STATIONS: FREE EXTRACT FROM SECTION 103 (4) FACTORIES ACT, 1937.

> Sub-sections (1) and (2) shall not apply where the processes or operations are only carried out for working an electric motor or apparatus which consumes electrical energy.

Sub-section (4) is not easy to explain, a fact which I have heard admitted by more than one Chief Inspector of Factories. The administration was anxious not to rope in somebody by mistake and I remember there were papers from the Post Office about their exchanges and radio telegraph stations, with others from people who had an oil engine with a generator for supplying their own electrical requirements and who did not wish suddenly to assume the dignity of becoming "electrical stations."

The internal discussions about this sub-section went on during the passage of the Bill through Parliament, in fact I recollect a telephone call about it from an Under-Secretary some two hours before it left the Lords for the Royal Assent. It was obviously a difficult point to cover in general terms and as there has been little or no trouble about it since it became law it must, I think, be regarded as successful in achieving the object which was in mind.

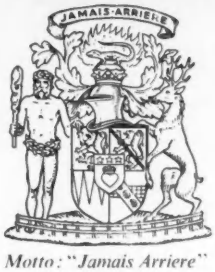
(To be continued)

Famous Scottish Names...

Douglas

The story of Mary Queen of Scots' escape from Loch Leven Castle is well known. One May morning at half past seven, after the Castle gates were locked, the keys were placed before Sir William Douglas (Laird of Loch Leven Castle) and his mother. "Little Willie Douglas", an orphan relation who acted as page, contrived to drop a napkin over the keys and carry them off. Mary was ready to start and Willie, after locking the gates to prevent pursuit, hurried the Queen to a small boat. Midway, the Queen gave the signal, Willie threw the keys into the loch and the Queen stepped ashore to be received by George Douglas and the waiting horsemen.

This is one of a host of 'Douglas' stories. Since the time of "The Good Sir James", the most famous of Bruce's Captains, the name 'Douglas' has dominated Scottish history. Sir James was a grandson of that William who possessed Douglasdale in 1174 to 1199, a territory from which the family name is derived.



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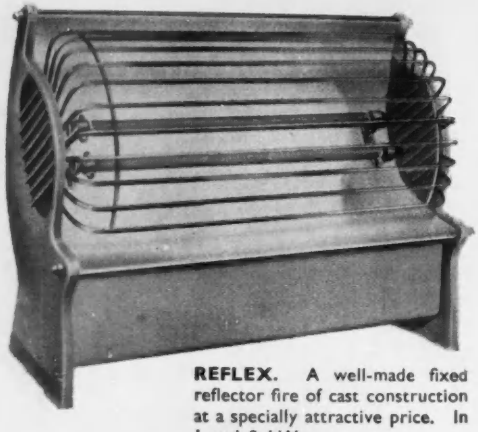

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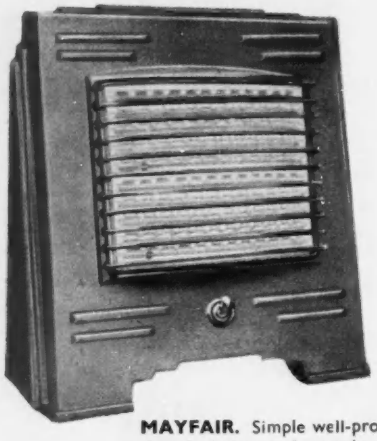

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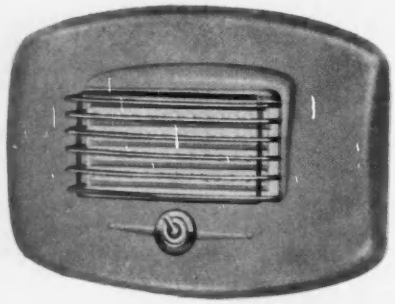

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ELECTRIC SUPPLY NEWS

Eire

IN about three years, it is anticipated, four small peat generating stations will be in operation by the Electricity Supply Board. Placed at Gweedore (Donegal), Screebe (Connemara), Miltown-Malbay (Clare) and Cahirciveen (Kerry), they will play their part in the Board's development programme and at the same time give employment in the area to turf producers. Contracts have been placed with German and Swedish firms for the turbo-generators, boilers and switch-gear required. The work of preparing the sites is to begin in about two months' time.

Gloucester

IT now seems likely that the public inquiry into the B.E.A.'s proposal to erect the 275 kV grid line from Hams Hall to Melksham, due to take place at Cheltenham on 27 Jan., will be cancelled because of lack of objectors, we learn. Gloucestershire and Worcestershire County Councils who originally led the opposition to the scheme have decided to drop their objections. As a result, the Warwickshire Council has reconsidered its position and may now limit itself to lodging a formal objection in writing to the Minister of Fuel and Power in order to leave the way open for possible discussions on minor points of detail such as the siting of individual pylons for the power line. The six Warwickshire district councils affected by the proposed route of the super-grid are expected to follow the county council's line, as Stratford-on-Avon Rural Council's General Purposes Committee has already agreed to do. The reason for the withdrawal of opposition has been given as "lack of supporting evidence from the electrical experts." The super-grid is obviously of such over-riding importance that few technical opinions can be found against it and the proposed route of the West Midlands line from Hams Hall power station, near Coleshill, to Melksham in Wiltshire, where it will join with the London-Bristol branch, appears the most reasonable. The Warwick Rural Council last week expressed its opposition to the scheme, and were told that the county was making representations to the Government.

Great Yarmouth

THE Town Planning Committee has approved further plans and elevations of the new South Denes power station submitted by the B.E.A. The latter has accepted all the Committee's suggestions about building lines, and the Committee has approved a proposal that the chimney should be built of concrete instead of bricks.

Hebburn-on-Tyne

THE Urban Council General Purposes Committee has invited the North-Eastern Electricity Board to discuss with the Council the supply of electricity to houses in the Spencer Street area at present served only by gas. The Board had previously stated that the work could not be started immediately as the existing network could not carry the extra load and a new substation would have to be erected.

Lake District

A RECENT meeting of the Lake District Planning Board it was stated that after a conference between the North Western Electricity Board, the National Parks Commission and the planning board on the provision of electricity to the valleys and dales of the Lake District and in particular to Borrowdale and Langdale, the Electricity Board proposed to submit particulars of proposed routes and distribution so that all preliminary questions could be agreed in advance. Mr Dobell, a member of the Planning Board, said that it was felt that if all interested parties could discuss the matter before the Electricity Board was ready to proceed, a great deal of time could be saved.

Lincolnshire

PROGRESS made in rural electrification work of the Yorkshire Electricity Board in North Lincolnshire has been outlined by Mr D. R. Williams, manager of the Board's No. 7 sub-area. Since March, 1953, a total of 29 villages had been supplied with power, and the rate of rural development had surpassed that of every previous year since the launching of the scheme in 1949, he said. At vesting day there were 144 villages connected in the sub-area. At the end of this month the number will be 234. Among the latest communities to be given a power supply were North Willingham, Sixhills, East Stockwith, Grayingham, Farforth, Maidenwell and Muckton. New work was progressing on the final four villages, Haugham, Legsby, Bransby and Buslingthorpe. When it was completed the only village without a supply would be Kelstern, where, to date, property owners had declined to wire their houses and cottages.

Louth

IN cleaning out waterways under which cables pass, workers employed by the Louth Drainage Board were often exposed to danger of electrocution, it was stated at a recent meeting of the Board. The Yorkshire Electricity Board had been asked to supply maps indicating where their cables crossed drains and waterways. The surveyor, Mr D. C. Morris said the Drainage Board had received a letter from the Yorkshire Electricity Board stating that a cable had been damaged under the old Fleet drain at North Coles, and suggested that the Drainage Board should be liable for the cost of repairs. The clerk, Mr W. A. Slack, had replied asking on what authority the Electricity Board had laid cables across the drain, and pointing out that serious injury could have been caused to the workmen on the drain.

Newcastle upon Tyne

THE City Council's Health Committee has recommended that statutory notice should be served on the B.E.A. as a preliminary to legal action against them, in connection with an alleged grey dust nuisance from Dunston power station. At a recent meeting of the Committee it was stated that residents had frequently complained about the dust nuisance. There had been negotiations with the B.E.A. who had intimated that they were doing all they could.

Newry

WITH the pumping machinery feeding the Newry Canal rapidly reaching the end of its economic life, the Newry Port and Harbour Trust is considering the possibility of installing electrically driven pumps for which an outside power supply would be needed. The question has now arisen whether it would be cheaper to take a power supply over the border from Southern Ireland at a point about a mile from the locks, or from Newry which is three miles distant. The secretary of the Harbour Trust is contacting the Eire Electricity Board and the Electricity Board for Northern Ireland on the matter.

North of Scotland

THE first part of the North of Scotland Hydro-Electric Board's £316,000 power supply scheme for North-West Sutherland and part of Caithness has been completed from Thurso out to Melvich and including Strath Halladale. The switch-on ceremony is taking place today, Thursday, at Melvich Public Hall. The scheme will serve about 200 consumers, including many crofters. At present the board's engineers are working on the rest of the scheme, which will extend as far west as Tongue and Melness.

North Eastern

AT the quarterly meeting of the North-Eastern Electricity Consultative Council at Newcastle-on-Tyne, it was reported that 134 substations had been put into operation. The majority of these were in connection with supplies to villages and farms and the others were for new housing estates and for reinforcing existing networks. During the same period, high voltage supplies were afforded to nine industrial and commercial consumers, and 145·9 miles of cables and mains were commissioned. The number of farms con-

nected was 111 while negotiations were completed for supplying a further 426 farms. During the three months nine villages were brought on supply in the Tyne sub-area, two in the Wear sub-area, two in Harrogate sub-area, and three in York sub-area. New developments approved by the Electricity Board since the last meeting of the Consultative Council include 70 schemes for supplying housing estates and 126 for rural supplies costing £758,250. It is announced that work on erecting the line to Whittonstall (Tyne sub-area) has commenced, after being held up on account of open-cast mining borings.

LIGHTING SCHEMES

Camborne - Redruth. The U.D.C. Lighting Committee is considering relighting A30 road, and is seeking ministerial approval.

Grantham. The scheme for conversion from gas to electricity of the whole of the town's street lighting is being submitted to the M.o.T. by the T.C.

Ilfracombe. Members of the Council are anxious to have street lighting converted from gas to electricity. The South Western Electricity Board is preparing estimates.

Middlesbrough. The divisional road engineer of the M.o.T. has told the committee he will be prepared to support schemes to be carried out by the council this year at a cost not exceeding £6,000. The Watch and Licensing Committee is dissatisfied with that decision.

Salford. Application has been made for consent to borrow £14,567 in connection with schemes for the improvement of street lighting in Eccles New Rd and Liverpool St, Salford 5, and Langworthy Rd.

Southend-on-Sea. The T.C. has approved proposals for this year's illuminations scheme, to cost £16,233.

Sutton Coldfield. Street lighting on Falcon Lodge Estate is to be extended at an extra cost of £4,500.

COMPANY ACTIVITIES

I WAS so surprised to learn of a reduction in Ferguson TV prices that I went down to the nerve centre of Thorn Electrical Industries at Enfield last week, to see what it was all about. It was no question of not being able to sell the sets. They, in fact, run off the production line one every 29 seconds, straight into waiting vans for the shops. No, it is all the result of wise factory replanning (costing £165,000) last summer, when in 14 days what was previously a machine shop was converted into what must be the finest system of TV production in the country.

While there, Jules Thorn, the chairman, told me the company owns and operates 12 factories, 10 of them in Gt. Britain and 2 overseas. The Enfield site is not the largest, but it is certainly the most important, because it is from there that all the group's research, development and engineering and production activities are directed and controlled. There, too, are five separate manufacturing units embracing (1) tele-communications, radar and electronics test gear; (2) television; (3) fluorescent tubes; (4) fluorescent phosphors and fine chemicals; and (5) automatic machinery.

There are 3,640 separate operations and components in the make-up of a Ferguson television receiver. A high proportion of the components are designed and produced in the Enfield factory. From the press shop a continuous stream of steel chassis frames and other metal stampings flows via the welding and riveting section into the plating department. Here on endless conveyors the chassis frames pass through an automatic electro-plating plant, the first of its kind in the world. When nearing completion, valves are fitted and cathode ray tubes, entering from a separate store by an overhead conveyor, are installed.

Of all the Atlas range of lighting products controlled by Thorn, the fluorescent tube section is surely the most exciting. Glass tubes, fresh from the washing plant are coated by a process unique in Gt. Britain. The suspension is sprayed down the tubes by a multi-head "gun," a new method giving more uniform coating, better adhesion and almost complete freedom from blemishes and pin holes.

Electronic devices automatically reject any finished tube failing to reach the required standards. Thorn's claim that they produce more fluorescent lighting tubes than all the rest of the industry put together.

I am glad Sir Alexander Roger, chairman of Telephone Properties, has climbed down from his original intention of not sharing out the money to be obtained from the sale of the Venezuelan telephone property. The company after all, is not a 100% investment trust, the Venezuelan undertaking having been its main investment. It is only equitable, therefore, that shareholders should have some say in the future.

The official scheme is not yet out but there is little doubt that it will take such form that shareholders will be given an alternative of either retaining an investment in the company; taking all their money out, or leaving some money in and taking some out. The shareholders' committee has submitted three plans for the board's perusal. One, it is believed, is modelled directly on the Cable and Wireless scheme.—*From our City Correspondent.*

British Electric Resistance Co.

To give effect to the one-for-one scrip issue, previously noted, an extraordinary meeting is called for 2 Feb. The directors state that £35,133 of the £50,000 to be capitalised will be provided by writing-up of the freehold and leasehold properties. The balance sheet value of the assets will then become £61,563, a figure which they have been told is considerably less than the lowest value that it would be reasonable, for any purpose, to place upon the company's properties at the present time. It is further emphasised that the proposed new issue is no indication that the total ordinary distribution will be increased.

British Industrial Plastics Ltd.

A welcome recovery has occurred in the group profits for the year ended 30 Sept. last, in line with the forecast at the annual meeting. The group profit for the year is £441,987 compared with £270,908 for the previous period. A final dividend of 12½% is now recommended to make a total of 20% for the year, against only one payment of 12½% in the preceding year. After allowing all charges, including taxation, the net profit for the past year is £104,120 (£33,489).

L. Sterne & Co.

The net profit for the year ended 31 Oct. last is £68,974 as against £94,327 for the previous period. The dividend is again 15%.

Dividends Declared

Cables Investment Trust.—Interim of 3% (*same*).

Globe Telegraph & Trust.—Interim of 3% (*same*).

Hackbridge Cable Holdings.—Interim of 7½% (*same*).

Sayings OF THE WEEK

"By taking electricity to Wales, England was repaying the debt she owed to the Principality for giving protection to the Tudor dynasty, and for forming the first branch of the Women's Institute," . . . MR W. GILCHRIST, chief commercial officer to the Merseyside and North Wales Electricity Board, speaking at Chester last week.

"Until street lighting is organised on a national basis and a greater contribution made from the Road Fund, the high rate of road accidents at night will continue," . . . MR. J. H. MORRISON, lighting superintendent to Bolton Corporation stated last week.

"There are many examples of young people who select their early jobs solely on the basis of the immediate wages they will receive and ignore other considerations, such as the suitability of the work and the long term prospects it offers," . . . in the report of the National Youth Employment Council published last week.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders, unless otherwise stated.

23 Jan.—Lanarkshire. Installation in Protestant primary school at Spittal. Applications by above date.—See 14 Jan. issue.

25 Jan.—Peterborough T.C. Installation at Walton school.—See 14 Jan. issue.

25 Jan.—Hythe (Kent) T.C. Street lighting along trunk road A.259.—Advertised in 14 Jan. issue.

25 Jan.—Bentley-with-Arksey U.D.C. Installation in 22 houses in Ausdell Rd. See 14 Jan. issue.

25 Jan.—Doncaster T.C. Installation in 18 flats and 11 shops on Beckett Rd site.—See 14 Jan. issue.

25 Jan.—Dunfermline T.C. Installation work at C.D. Control Centre, Broomhead. —See 14 Jan. issue.

25 Jan.—Bedfordshire. Lighting installation at "Rookwood," New Bedford Rd, Luton. Apply by above date to County Architect, Shire Hall, Bedford.

27 Jan.—Wandsworth B.C. Street lighting. Three separate tenders.—Advertised in 14 Jan. issue.

27 Jan.—Wigan T.C. Tenders invited for electrical work for housing schemes. Borough and Water Engineer, Municipal Buildings, Hewlett St.

27 Jan.—Friern Barnet U.D.C. Lamps for street lighting from 1 April.—Advertised in 14 Jan. issue.

29 Jan.—Bethnal Green B.C. Lamps, etc., from 1 April.—See 14 Jan. issue.

29 Jan.—Dublin. Electrically-driven pumps at Port of Dublin.—See 14 Jan. issue.

29 Jan.—Salford T.C. Thermal storage calorifier, centrifugal boiler feed pump, etc., at Blackfriars Public Baths.—See 24 Dec. issue.

29 Jan.—Belfast T.C. Telegraphs and operational telephones for power station West.—Advertised in 14 Jan. issue.

30 Jan.—Edinburgh. Lamps from 1 Apr. for S.E. Hospital Board.—See 14 Jan. issue.

30 Jan.—Durham. Public address system for county agricultural show.—See 14 Jan. issue.

30 Jan.—Huyton-with-Roby U.D.C. Public lighting and other equipment, during 1954-55. See 14 Jan. issue.

30 Jan.—Lanarkshire. Electrical installation in primary school at Bankhead, Leomahagow. Apply by above date to W. C. Brownie, county clerk, Lanarkshire Hse, 191 Ingram St, Glasgow.

30 Jan.—Ramsey (Hunts) U.D.C. Wiring of 90 houses at Pondersbridge, Ramsey St. Mary and Ramsey Heights. Surveyor, Council Offices, 36 Great Whyte.

30 Jan.—Prestwich T.C. Supply of lamps and equipment for 1954-55.—See 7 Jan. issue.

30 Jan.—Barry T.C. Supply of electrical goods during year ending 31 Mar, 1955. J. Proctor, Borough Engineer, Tynewydd Rd.

30 Jan.—Carlisle T.C. Electrical installation in flats at former isolation hospital. L. J. A. Stow, City Engineer, 18 Fisher St.

30 Jan.—Glasgow T.C. Supply of illuminated beacons for pedestrian crossings. Inspector of Lighting, 20 Trongate.

31 Jan.—Driffield (Yorks) U.D.C. Installation of electricity in bungalows on Gibson St estate. A. Hornby, clerk, Council Offices, Eastgate South.

1 Feb.—Durham. Electrical installation in Springwell county school. G. C. Clayton, county architect, Court Lane, Durham.

1 Feb.—Gillingham T.C. Supplies of switches, conduit, wire, cable and accessories for each, and lamps during year beginning 1 Apl. Borough Engineer, Municipal Buildings.

1 Feb.—Stoke-on-Trent T.C. Supply of electric lamps during 6 months ending 30 Sept. City Surveyor, Town Hall.

1 Feb.—Manchester T.C. Electrical installation in 334 houses in Greenwood Rd, (contract 199a); 30 flats in Shadow Moss Rd, (193b), and 37 maisonettes and 31 flats in Cambridge and Newcastle Sts. Director of Housing, Town Hall. Deposit £1. 1s.—Advertised in this issue.

1 Feb.—Dublin T.C. Automatic telephone exchange at Crooksling Sanatorium.—See 14 Jan. issue.

1 Feb.—N. Cotswold (Glos.) R.D.C. Pumps and auxiliary equipment and other works at Moreton-in-Marsh pumping station.—See 24 Dec. issue.

2 Feb.—Scottish Gas Board. Supply of electric lamps to Glasgow Div. for year from 1 April. Div. Controller, at 30 John St.

3 Feb.—Southwark B.C. Supply of electric lamps. Specifications seen at Town Hall, Walworth Rd, S.E.17.

3 Feb.—Donegal. Installation in District Hospital at Dungloe.—See 24 Dec. issue.

4 Feb.—Great Yarmouth T.C. Supply of electric cables for year from 1 April. Borough Engineer, Town Hall.—Advertised in this issue.

5 Feb.—Dalkeith T.C. Installation in 74 houses at Woodburn.—See 7 Jan. issue.

5 Feb.—Bilston T.C. Street lighting in group B on Bradley Lane estate.—See 14 Jan. issue.

5 Feb.—Southport T.C. Electrical installation in chemistry laboratory at King George V school. Borough Architect, 93-105 Lord St. Deposit £1. 1s.

6 Feb.—Banbridge (N. Ireland) R.D.C. Wiring of 36 houses at Kinallen, Moneyslane and Shaneghan. F. N. Miller, clerk to council, Council Offices, Linen Hall St. Deposit £2. 2s.

6 Feb.—Cheadle and Gatley U.D.C. Supply of concrete columns, lamps, lanterns, swan-neck brackets and switching gear boxes during 1954-55. D. S. Graham, Engineer and Surveyor, Town Hall, Bruntwood, Cheadle.

6 Feb.—Seaham U.D.C. Electrical installation in 150 houses. Merchants and suppliers also invited to tender for supply of electric wash-boilers. Engineer and Surveyor, Cliff House.

6 Feb.—Mitcham T.C. Electric lamps included in supplies wanted during 1954-55. Borough Engineer and Surveyor, Town Hall.

6 Feb.—Consett U.D.C. Lamps for street lighting during 1954-55.—See 14 Jan. issue.

6 Feb.—Solihull U.D.C. Fittings and lamps, etc., during year beginning 1 Apr. —See 14 Jan. issue.

6 Feb.—Swansea T.C. Public lighting supplies in year beginning 1 Apl.—See 14 Jan. issue.

8 Feb.—Crayford (Kent) U.D.C. Supply of electrical goods and boilers in year beginning 1 April. Engineer and Surveyor, Town Hall.

8 Feb.—Warrington T.C. Concrete lamp columns included among supplies wanted during 1954-55. Borough Engineer and Surveyor, Town Hall.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries

A Selection from the 91 Queries answered this week

"Catholier" cold cathode fittings—makers of? — S.E.E.B.—Micramatic, Ltd., Wootton Mount, Old Christchurch Rd, Bournemouth.

"Universal" and Magic washing machines. — agents for? — S.E.B.—"Universal"—L. G. Hawkins and Co., Ltd., 30/35 Drury Lane, W.C.2, and "Magic" — Metalcraft Mftg. Co. (Canada), Ltd., 39 Berners St, W.1.

Soldering tool, thermostatically controlled, for Polythene tubing, to be up to 4 in. wide.—makers of?—B.C.L.—Theco Electrical Appliances Ltd., 33 Theobald's Rd, London, W.C.1.

"A.C.S." thermostats—makers of?—D.C. — Robert Maclaren and Co., Ltd., Eglinton Works, Kilbine St, Glasgow C.5.

"Rowlett" toasters — makers of?—E.M.E.B.—Rowlett Eng. Co., Ltd., East Rd, Burnt Oak, Edgware.

"Teledim" dimmers—makers of?—W.E.—A. E. Sommers and Co., Ltd., 96a Sydenham Rd, London, S.E.26.

"Browleco" soldering irons—makers of? — G.C.L. — Browning's Electric Co., Ltd., Boleyn Castle, Green St, London, E.13.

Clegg and Coupe Ltd.—address of?—T.E. — Molesworth St, Rochdale, Lancs.

9 Feb.—Bath T.C. Supply during 1954-55 of lamps, cables, control gear, steel columns, lanterns, etc., for street lighting. —See 14 Jan. issue.

9 Feb.—Cannock U.D.C. Street lighting equipment and fittings wanted in year beginning 1 Apl. E. Lomax, Engineer and Surveyor, Council House, The Green.

10 Feb.—Minehead U.D.C. Street lighting in Park St, the Parade and the Avenue.—See 14 Jan. issue.

11 Feb.—Metropolitan Water Bd. Supply of electric lamps during year from 1 Apl. Chief Engineer, New River Head, Rosebery Ave, E.C.1.

12 Feb.—Belfast T.C. Heating installation at Power Station East.—Advertised in 14 Jan. issue.

12 Feb.—Belfast T.C. Supply of street lighting remote control equipments and control switches. Forms (No. W.27) from Electricity Dept., East Bridge St. Deposit £1. 1s.—Advertised in this issue.

13 Feb.—Altrincham T.C. Supply of concrete lighting columns for year ending 31 Mar., 1955. Borough Surveyor, Town Hall.

13 Feb.—Huddersfield. Supply of tungsten filament, mercury vapour and sodium lamps, cables, for year beginning 1 Apr. Borough Engineer and Surveyor, High St Buildings.

13 Feb.—Stockport T.C. Supply of electric lamps for schools wanted for year ending 31 Mar., 1955. Director of Education, Town Hall.

20 Feb.—Higham Ferrers T.C. Supply and erection of 39 concrete columns and brackets with lanterns, 150 W tungsten lamps, etc., in class B. Borough Surveyor, Town Hall.

5 Mar.—Belfast T.C. Seven 220,000 lb/hr stoker fired boiler units and other plant for power station West.—Advertised in 31 Dec. issue.

5 Mar.—Belfast T.C. Feed heating and condensing plant sets; and piping, steam receivers and associated valves, electrical controls, fittings, etc.—Advertised in 7 Jan. issue

No date stated—Bristol. Supplies to Southmead Hospital Group Management Committee.—See 14 Jan. issue.

No date stated.—N. of Scotland H.E. Board. Lighting, heating and subsidiary services installation at Fort Augustus.—Advertised in 14 Jan. issue.

No date stated—Cardiff. Supplies of electric cables, lamps and fittings for Hospital Management Committee during year beginning 1 Apr. Forms from Supplies Officer, City Isolation Hospital, Canton, Cardiff.

No date stated.—N. of Scotland H.E. Board. Wood pole o.h. lines in Sutherland.—Advertised in 14 Jan. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Road, W.C.1, quoting reference.*

8 Feb.—India. Supply of total of 4,175 yds trailing cable to various specifications. Quote ref: SE-3/19865-D/20558-D/IV. Director General, Industries and Supplies, Shahjahan Rd, New Delhi. B.o.T. (Ref: 13/54).*

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, 19 January

	£ per ton	Weekly change £	Price last year £
COPPER, standard class A (settlement)	220	−9	285
,, (3 months)	209	−11	—
LEAD, refined pig, min. 99·97% purity (cash)	82	−7¼	99½
,, (3 months)	82½	−5½	96½
TIN, refined, min. 99·75% purity (settlement)	655	−10	965
,, (3 months)	625	−5	943
ALUMINIUM, ingots 99-99·5%	156	—	166
ZINC, virgin, min. 98% purity (cash)	70½	−4½	88
,, (3 months)	69½	−3	87½
RUBBER No. 1, RSS. spot (per lb.)	17½d.	—	25d.
,, c.i.f. basis, ports. Mar. (per lb.)	17d.	−1/16d.	24½d.
ARMOURING:			
Galv. Steel Wire (0·104 in.)	51½	—	52
Mild Steel Tape (0·014 in.)	40	—	39½

10 Feb.—India. Ahmedabad Municipal Corpn. requires supply of six electrically driven sewage pumping sets, for Ellisbridge Drainage pumping station. Municipal Commissioner, Ahmedabad. B.o.T. (Ref: ESB 516/54).*

12 Feb.—Australia. Supply of 500 single-phase, 2-wire, maximum demand indicators with max. scale value and current rating of 6 A (E.31/53). Chief Engineer and Manager, Dept. of Electricity, Kelvin Hse, Adelaide St, Brisbane. Fee 10s. 6d. per copy. B.o.T. (Ref.: ESB 13313/53).*

12 Feb.—India. Supply of a 120 h.p. endless haulage gear, rope speed 2 m.p.h., carron drive with non-flameproof motor for 3,300 V, 50 c/s 3-phase supply, and complete with switchgear, controls, etc. Director General, Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (Ref: ESB 360/54).*

17 Feb.—India. Supply for Government of Travancore-Cochin of 1,560 cast iron cable jointing boxes with fittings and accessories and suitable for various sized cable. Secretary, Stores Purchase Committee, Trivandrum. Fee Rs.10. B.o.T. (Ref: ESB 529/54).*

28 Feb.—Iran. Supply and erection of refrigerated storage space at Khorramshan with capacity of 1,000 tons of dried fruit and 2,000 tons dates. Power available at 220/380 V, 50 c/s, 3-phase. Offers to USOM/Iran, Procurement Officer, c/o American Embassy, Tehran. B.o.T. (Ref.: ESB 13136/53).*

28 Feb.—Brazil. Supply and installation of mechanical and electrical equipment for hydro-electric plant at Cachoeira Dourada: includes hydraulic turbines, synchronised alternators, auxiliaries, transformers and other electrical equipment. Commission for study and execution of H.-E. works at Cachoeira Dourada, Rua 18, No. 5, Goiana, State of Goias. B.o.T. (Ref: ESB 215/54).*

2 Mar.—New Zealand. Tenders (PSS 54) invited for prototype and other radio transmitting and receiving equipment by Post and Telegraph Dept., Windsor Building, Willis St, Wellington. B.o.T. (Ref: ESB 13500/53).*

6 April—Uruguay. Supply of vehicle specially equipped to detect faults in underground cables—3-phase, a.c., 50 c/s of 220 V, 6,300 V and 31,500 V. Max. length of these cables is 7,300 metres (No. 3945/54). Administracion General de las Usinas Electricas y los Telephonos del Estado. B.o.T. (Ref: ESB 12690/53).*

16 Mar.—New Zealand. Tenders (No. 251) invited for supply of 8 single-phase, double wound transformer units, each 6,666 kVA, 110/19·05 kV, 50 c/s, outdoor type, oil immersed and preferably natural cooled. State Hydro-Electric Dept., Wellington. B.o.T. (Ref: ESB 13182/53).*

Contracts Placed

Salford T.C. Conversion of d.c. supply at Frederick Rd depot to a.c. and installation of switchgear and cabling, etc., N.W. Electricity Board, £2,800.

Sedgley U.D.C. Street lighting in Tipton, Vicar and Gospel End Sts, Revo Electric Co., Ltd., £1,881.

Gazette Announcements

COMPANIES ACTS

Mead Electric Co., Ltd. J. R. Mackenzie Valentine, Suffolk Hse, Laurence Pountney Hill, E.C.4, has been appointed liquidator by members.

Kolar Mines Power Station Ltd. Meeting of members will be held at Oorgaum, Mysore State, S. India, on 19 Feb. at 11 a.m. to receive liquidator's report.

Fairclough (Leeds) Ltd. Last day for receiving proofs in respect of intended dividends, 26 Jan. Liquidator is W. H. Meredith, Official Receiver, 29 East Parade, Leeds.

BANKRUPTCY ACTS

First Meeting

Harrogate. Norman Lusher, electrician, trading at 18b Oxford St, Harrogate. Meeting at Official Receiver's Office, 29 East Parade, Leeds today (Thurs.) at 11 a.m., and public exam. at Court House, Raglan St, Harrogate, on 26 Feb. at 10.30 a.m.

Public Examination

Southend. Albert F. Ayres, electrical contractor of 84 Coleman's Ave, Southend-on-Sea. Examination will be at 102 Alexandra Rd, Southend, on 25 Mar. at 11 a.m. First meeting took place on Tues.

Appointment of Trustee

London. Francis E. Thorne, electrician, of 44 Cranhurst Rd, Cricklewood, N.W.2. Trustee is D. H. Pexton, inc. acc., 107 Jermyn St, S.W.1.

Dividends

Canterbury. Leonard F. Kent, radio and electrical engineer of 32 High St, Broadstairs. Second and final dividends of 6s. 7½d. in £ payable at Official Receiver's Office, 1 The Parade, Canterbury, on 29 Jan.

BUSINESS PROSPECTS

Home

Barnard Castle. N.E. Housing Association, Northumberland Rd, Newcastle, to erect 40 houses, shops and flats on Green Lane estate.

Bracknell (Berks). E. A. Ferrify is architect for factory proposed by Corrugated Wrappers Ltd., at new town. His address is Ferley Hall, Binfield.

Bishop Auckland U.D.C. Erection of 28 houses, 2 bungalows and community hall at Coundon. Surveyor, 50 North Bondgate.

Blyth T.C. Redevelopment scheme being considered for Coomassie Rd, and Crofton area involving about 260 dwellings, including 8-storey blocks of flats.

Carlisle. Batey and Son, Brampton, propose bottling and mineral water factory on Durranhill estate. Johnstone and Wright, 13 Castle St, Carlisle, are architects.

Chigwell U.D.C. Erection of 32 flats in Rectory Lane, Loughton. Tooley and Foster, Midland Bank Chambers, Buckhurst Hill, Essex.

Co. Down. Erection of intermediate school at Donaghadee. V. B. Evans, quantity surveyor, 3 Bradbury Place, Belfast.

Dudley T.C. Approval sought for erection of 170 houses on Sledmere estate. Tenders to be invited for construction of flats in Hall St. Approval received for 32 houses and 16 flats on Old Park Farm estate. Tenders likely to be invited soon for structural work in erection of Simms Lane secondary school.

Durham. It is intended to renew electrical installations at Hartlepool Baltic St school, and Hartlepool Hart Rd school. Costs will be £1,500 and £970 respectively.

East Cowes (I.o.W.). Erection of further 60 houses on Kent House estate for local Housing Association. Architect is V. Aldridge, 35a St. James' St, Newport, I.o.W.

Gateshead. North-Eastern Trading Estates' programme for 1954 includes building six factories and extending 13 others on Team Valley Trading estate.

Hammersmith. E.N.V. Engineering Co., Ltd., propose to extend factory in Hythe Rd at estimated cost of £50,000.

Hemel Hempstead. Erection of 81 dwellings at Apsley/Bennetts End for Development Corpn. Quantity surveyor is V. B. Johnson, Faircross Hse, High St, Watford.

Hull T.C. Application to be made to borrow £150,817 for erection of Eastmount secondary school in Sutton No. 2 residential area.

Hull T.C. Approval given to proposals to re-wire St. Vincent's R.C. School.

Ilkeston T.C. Erection of 50 houses on Kirk Hallam estate. A. O. Marshall, Borough Engineer and Surveyor, Town Hall.

Lanarkshire. Erection of 1,032 houses on 13 sites. County Housing Architect and Engineer, 23 Beckford St, Hamilton.

Lambeth. Brixton Estates Ltd. have £46,000 licence to build single storey factory and attached showrooms, offices and canteen in Foxley Rd. Lewis Solomon, Son and Joseph, 21 Bloomsbury Way, W.C.1, are architects.

Lincolnshire. Secondary modern school to be built in Burgh Rd, Skegness. Estimated cost of single school (including equipment) at Brigg is £110,655.

Mansfield T.C. 460 houses to be erected in Brick Kiln Lane area.

Monmouthshire. Erection of junior school at North Croesyceiliog. C. L. Jones, county architect, Queen's Hill, Newport.

Morpeth R.D.C. This year's programme includes erection of 130 houses, and possibly, old people's dwellings at Broomhill.

N. Witchford (Isle of Ely) R.D.C. It is suggested that 40 houses be built in Westfield Rd, Manea.

Newport (Mon.). Clothing firm of H. Lotery and Co., Ltd., are to extend factory by 15,000 sq ft.

Northamptonshire. Work to start soon on first part of technical college in Corporation St, Corby. Cost will be about £75,000.

Northallerton U.D.C. Erection of 70 houses in Bullamoor Rd. P. Hartley, clerk, Council Offices, The Friarage, 72 High St.

N. Ireland. Construction of factory on site 12 of Carnomoney Factory estate, Belfast. Min. of Commerce (Room 28), Chichester Hse., Chichester St, Belfast.

Peterborough T.C. Eighty flats and 8 houses to be built to complete Dogsthorpe North estate.

Plymouth T.C. Installations in 95 houses in Chaucer Way, D.C. Engineering Co., Ltd., £2,005.

Preston T.C. Construction of Ashton I county secondary school. Borough Engineer and Surveyor, Municipal Building.

Royston (Herts) U.D.C. 70 houses and 2 flats to be built on Newmarket Rd estate.

Runcorn R.D.C. Approval granted for erection of 120 houses at Frodsham, Appleton, Kingsley and Antrobus.

Skelmersdale (Lancs) U.D.C. Approval received to layout of 173 dwellings on Manor House Farm estate.

South Shields. Plans in hand to build clinic and ambulance station in Boldon Lane at cost of about £32,550. It is proposed also to build communal hall, flats and library in same district.

Sunderland T.C. Electricity to be installed at St. Columba's C.E. voluntary school.

Swansea T.C. Approval sought for 300 houses at Trallwn, 130 houses at Portmead, and others at Penlan, Clase, West Cross and Portmead.

Washington (Dur.) U.D.C. Tenders to be invited for installation of electric lighting in old persons' houses at Westwood Gdns. and The Terraces.

Wilton T.C. Erection of 29 flats in three blocks. Council's Architects, Potter and Hare, De Vaux House, Salisbury.

Overseas

Belgium. Establissement Malvin, 50-52 rue Josse Impens, Brussels, wish to obtain agency of U.K. manufacturer of small domestic refrigerators of 100 to 150 litres capacity.

South Africa. Mr F. H. Flanter of F. H. Flanter and Co., Buitencingle St, Cape Town, wishes to obtain U.K. agencies in electrical field. Connections wanted in telecommunications, electrical instruments, electrical supervising control equipment, cables and wires, signalling equipment and installation material. The firm are telephone and electrical engineers able to afford installation and servicing facilities as well as sales promotion.

TRADE NOTES

Arrangement. Chamberlain Industries Ltd., Staffa Works, Leyton, London, E.10, have made an aggrement with Walter P. Hill, Inc., Detroit, Michigan, U.S.A., for the manufacture and sale of their special purpose machinery, principally for the production and testing of engineering parts made from tube and plate.

Change of Address. Saxon Components Ltd., have moved to Stow Works, 177 Kingsland Rd, London, E.2. Telephone: Clerkenwell 8977.

New Telephone No. The telephone number of the Northern Aluminium Co.'s Leeds area sales office is now Leeds 33621.

Beama Contract Price Adjustment Formulæ.—*For Electrical Machinery and Equipment.* For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Jan., 1954, shall be deemed to be 141s. 6d.; (*b*) "Cost of Materials"—the index figure for materials used in the Electrical Machinery Industry published in the Board of Trade Journal on 16 Jan., 1954, is 157·3.

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Jan., 1954, shall be deemed to be 141s. 6d.; (*b*) "Cost of Material"—the index figures published in the Board of Trade Journal on 16 Jan., 1954, are: Materials used in Mechanical Engineering Industries—147·6; "Blast Furnaces and Iron and Steel Melting and Rolling (40 and 41)"—144·0. The price of brass condenser tubes, ¾ in. o/d, 18 s.w.g. published in *The Metal Bulletin* on 15 Jan., 1954, is 3s. 4¼d. per lb.

For outstanding Contracts covered by the B.O.T. Intermediate Products Index. For purposes of calculating variations in (*a*) "Rates of pay"—the rate of pay for adult male labour at 16 Jan., 1954, shall be deemed to be 141s. 6d.; (*b*) "Cost of Material"—the index figure for Intermediate Products published in the Board of Trade Journal on 16 Jan., 1954, is 351·6.

Fire. There was an outbreak of fire at the works of the Reliance Electrical Wire Co. at Leyton on the evening of Saturday, 9 Jan., but thanks to the prompt attendance and excellent work carried out by the Fire Brigade and the Salvage Corps the damage was very limited, and plant was completely unaffected. An emergency squad recruited from amongst local employees worked throughout Sunday to such good effect that the factory commenced work on Monday under almost normal conditions.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.

John F. Askam (Consulting Engineers) Ltd., Guildhall Bldgs, Navigation St, Birmingham 2. Nom. cap.: £1,000. Dirs.: J. F. Askam, senr., and Mrs. G. Askam.

A. Blundell and Co., Ltd., Stephen St, Coventry. Precision, technical, electrical, automobile, aeronautical, acoustic and general engineers, Swiss auto workers, etc. Nom. cap.: £10,000. Permt. dirs.: A. Blundell, D. A. Blundell and R. A. Blundell.

Coopers of Tamworth Ltd., 17 Market St, Tamworth, Staffs. Decorators' merchants and electric goods retailers, radio and television suppliers and suppliers of household goods and domestic appliances carried on as "Coopers of Tamworth" at Market St, Tamworth. Nom. cap.: £10,000. Permt. dirs.: C. Northin and Annie F. Northin.

Hudson and Carter Ltd., Central Chambers, High St, Long Eaton, nr. Nottingham. Electrical engineers and contractors, manufacturers of and dealers in wireless apparatus, etc. Nom. cap.: £2,000. Dirs.: H. Hudson and A. W. Carter.

Fred Parrish and Sons Ltd., 441 Tong St, Dudley Hill, Bradford. Plumbers, sanitary, heating, mechanical, electrical and general engineers, etc. Nom. cap.: £1,000. Dirs.: F. Parrish, H. Parrish and E. C. Parrish.

John Patton and Co., Ltd., 408 Strand, W.C.2. Manufacturers of and dealers in electronic devices, repairers and hirers of electrical and mechanical apparatus, particularly wireless and television sets, etc. Nom. cap.: £100. Dirs.: M. J. Weaving and Claudia E. Jackson.

Redheugh-Willey Ltd., Tan Lane, Exeter, Devon. Constructional and mechanical engineers, gas, electrical, pneumatic, hydraulic, sanitary and general engineers, etc. Nom. cap.: £100,000. Dirs. to be appointed by subs. Subs.: H. L. Wrigglesworth, 15 Pondfield Cres, St. Albans, and J. W. Baggett, 90a Highgate High St., N.6.

H. I. Petts Ltd., 142 Station Rd, Mickleover, Derby. To take over business of electrical contractor carried on at Mickleover, Derby, by H. I. Petts. Nom. cap.: £100. Dirs.: H. I. Petts and Mrs. D. Petts.

Ridac Ltd. Consultants in electrical and mechanical engineering, etc. Nom. cap.: £100. Dirs.: Not named. Subs.: K. E. Enderby, 27 Benedict Rd, S.W.9, and Eleanor P. Fyrth, 56 Highbury Hill, N.5.

Atkinson, Son and Co., Ltd., 282 High Rd, Willesden, N.W.10. Manufacturers of and dealers in electrical appliances, etc. Nom. cap.: £500. Dirs.: F. V. Atkinson and Mrs. C. E. Atkinson.

Eltray Distributors Ltd., 9/10 Tottenham Mews, W.1. Mechanical, electrical and general engineers and consultants, etc. Nom. cap.: £9,000. Dirs.: to be appointed by subscribers. Subs.: J. L. Burles and Kathleen P. Gibson, 6 Austin Friars, E.C.2.

Freeden's Electrical Supplies Ltd., 30 Finsbury Sq, Moorgate, E.C.2. Nom. cap.: £2,500. Dirs.: B. H. Clarke and Gladys L. Brown.

Cables and Equipment Ltd., Ashtonville, Chalton, Beds. Designers and manufacturers of and dealers in electrical apparatus of all kinds, etc. Nom. cap.: £200. Permt. dirs.: W. H. Burnet and A. G. Tearle.

Andreae Automatic Machinery Ltd., Bank Chambers, Egham, Surrey. Manufacturers of and dealers in automatic machines, mechanical and electrical slot machines, etc. Nom. cap.: £100. Dirs.: E. C. Andreae and A. M. Bairstow.

Rotary Switches Ltd., Old Rd, Prestwich, Manchester. Constructors, developers, marketers, sellers or hirers of the patented mechanism known as rotary combination switches, etc. Nom. cap.: £500. Dirs.: J. H. Holt and J. E. Prosser.

Electro Surgical Instruments Ltd., 79 St. Martins Lane, W.C.2. Manufacturers of and dealers in electric surgical instruments, medical or other scientific equipment, etc. Nom. cap.: £100. Dirs.: J. J. Warren and H. A. E. Talley.

Granchy Ltd., 6 Bedford Row, W.C.1. Electrical equipment wholesalers, etc., Nom. cap.: £100. Dirs.: C. A. Carabott and G. J. Cassar.

Cole and Kirby Ltd. Motor, mechanical, electrical and general engineers, etc. Nom. cap.: £1,000. Permt. dirs.: B. Cole, 6 Chantry Close, Harrow, Mdx., and J. W. Kirby, 30 Braemar Gdns, Colindale, N.W.9.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

HED Ltd. in design. B707,125. Class 9. Transformers, rectifiers, electric-arc welding apparatus and current control apparatus for use therewith; contact devices and magnetising apparatus. Hirst Electronic Development Ltd., Eastdown Works, Dermody Rd, S.E.13.

D Maxi—Q. 720,798. Class 9. Scientific, electrical, radio and electronic signalling instruments and apparatus; and talking machines. Denco (Clacton) Ltd., 355/359 Old Rd, Clacton-on-Sea.

Ellison, 721,284. Class 9. Junction and branch boxes, circuit breakers, apparatus for use in operating machines, engines and motors by current control, etc. Geo. Ellison Ltd., Wellhead Lane Works, Wellhead Lane, Perry Barr, Birmingham 22.

Sen Ter Cet in design. B721,056. Class 9. Current rectifying instruments and apparatus. Standard Telephones and Cables Ltd., Connaught House, 63 Aldwych, W.C.2.

Betrolite. 723,997. Class 9. Insulated electric cables and wires and parts of electrical apparatus and instruments all made of plastics. L.P.S. Electrical Co., Ltd., Ealing Rd, Alperton, Middx.

Arexone. 724,105. Class 9. Insulated electric wire and cables. Arex Ltd., 17 Irving St, W.C.2.

MEETINGS TO NOTE

THURSDAY, 21 JAN.

I.E.E. (London Utilisation).—"Electricity in the Wool Textile Industry." A. J. Francis and T. H. Carr. Savoy Place, W.C.2, 5.30 p.m.

TELEVISION SOC.—"American Television." J. Sieger. Cinematograph Exhib. Assoc., 164 Shaftesbury Ave, W.C.2, 7 p.m.

INCORP. PLANT ENGRS. (Blackburn).—"Power Factor Correction." C. W. Sutcliffe. Grosvenor Hotel, Lord St, 7.30 p.m.

S. WALES INST. OF ENGINEERS.—Annual dinner at Park Hotel, Cardiff, 6.30 p.m.

I.E.S. (Bradford).—"Glassware in the Lighting Art." M. Keenan. Elect. Offices, 45-53 Sunbridge Rd, 7.30 p.m.

A.S.E.E. (Kent)—Lecture at Bridge Cafe, High St, Tonbridge, 8 p.m.

FRIDAY, 22 JAN.

INSTN. OF MECHANICAL ENGRS.—"Graphical Solution of Transient Vibration Problems." R. E. D. Bishop. Storey's Gate, London, S.W.1, 5.30 p.m.

COVENTRY ELECTRIC CLUB.—Annual dinner and dance.

I.E.E. (Southern).—"Receiving Aerials for British Television." F. R. W. Strafford. Technical College, Weymouth, 6.30 p.m.

MONDAY, 25 JAN.

I.E.E. (London Radio).—Discussion on "Should Sound Broadcasting of the Future be entirely in the V.H.F. Band?" A. J. Biggs. Savoy Place, W.C.2, 5.30 p.m.

I.E.S. (Leeds).—"Effect of Light on Growth and Development of Plants." Miss D. Vince. 24 Aire St., 6.15 p.m.

I.E.S. (Leicester).—"Signs and Display Lighting." C. Higgins. Elect. Offices, Charles St., 7.30 p.m.

I.E.S. (Stoke-on-Trent).—Annual dinner at Grand Hotel, Hanley.

I.E.E. (S. Midland Radio).—"Method for Synthesis of Speech." W. Lawrence. James Watt Memorial Inst., Gt. Charles St., Birmingham, 6 p.m.

I.E.E. (Reading).—"Training in Electronic Fire Control in R.E.M.E." Capt. R. A. Middleton. George Hotel, 7.15 p.m.

TUESDAY, 26 JAN.

I.E.S. (London).—Discussion on "Design of Lighting Fittings." 2 Savoy Hill, W.C.2, 6 p.m.

I.E.E. (N. Midland).—Discussion on "Teaching Electrostatics." S. Barnett. Huddersfield Tech. College, Queen St. South.

I.E.E. (N.W. Measurements).—"Alternating-Current-Instrument Testing Equipment." A. H. M. Arnold. Engrs. Club, Albert Sq., Manchester, 6.15 p.m.

WEDNESDAY, 27 JAN.

INSTN. OF MECHANICAL ENGRS.—Discussion on "Glands and Seals for Rotating Shafts." Storey's Gate, London, S.W.1, 6.45 p.m.

E.C.A.—Annual dinner at Grosvenor Hse., London.

I.E.E. (S. Western).—"Electronic Telephone Exchanges." T. H. Flowers. Electric Hall, Torquay, 3 p.m.

THURSDAY, 28 JAN.

INST. OF FUEL (E. Midland).—"Coal Problem." D. Hicks. Gas Showrooms, Nottingham, 6.15 p.m.

I.E.E. (Bristol Students).—"Electronic Organs—How They Work." T. G. Flynn. Tech. College, Gloucester.

INCORP. PLANT ENGRS. (Sheffield).—"Planned Maintenance." O. F. Lewis. Grand Hotel, 7.30 p.m.

I.E.E. (S. Midland).—"Royal Festival Hall: Electrical Installation." J. G. Hunter. Works Inst., Hylton Rd. Power Station, Worcester, 7.15 p.m.

FRIDAY, 29 JAN.

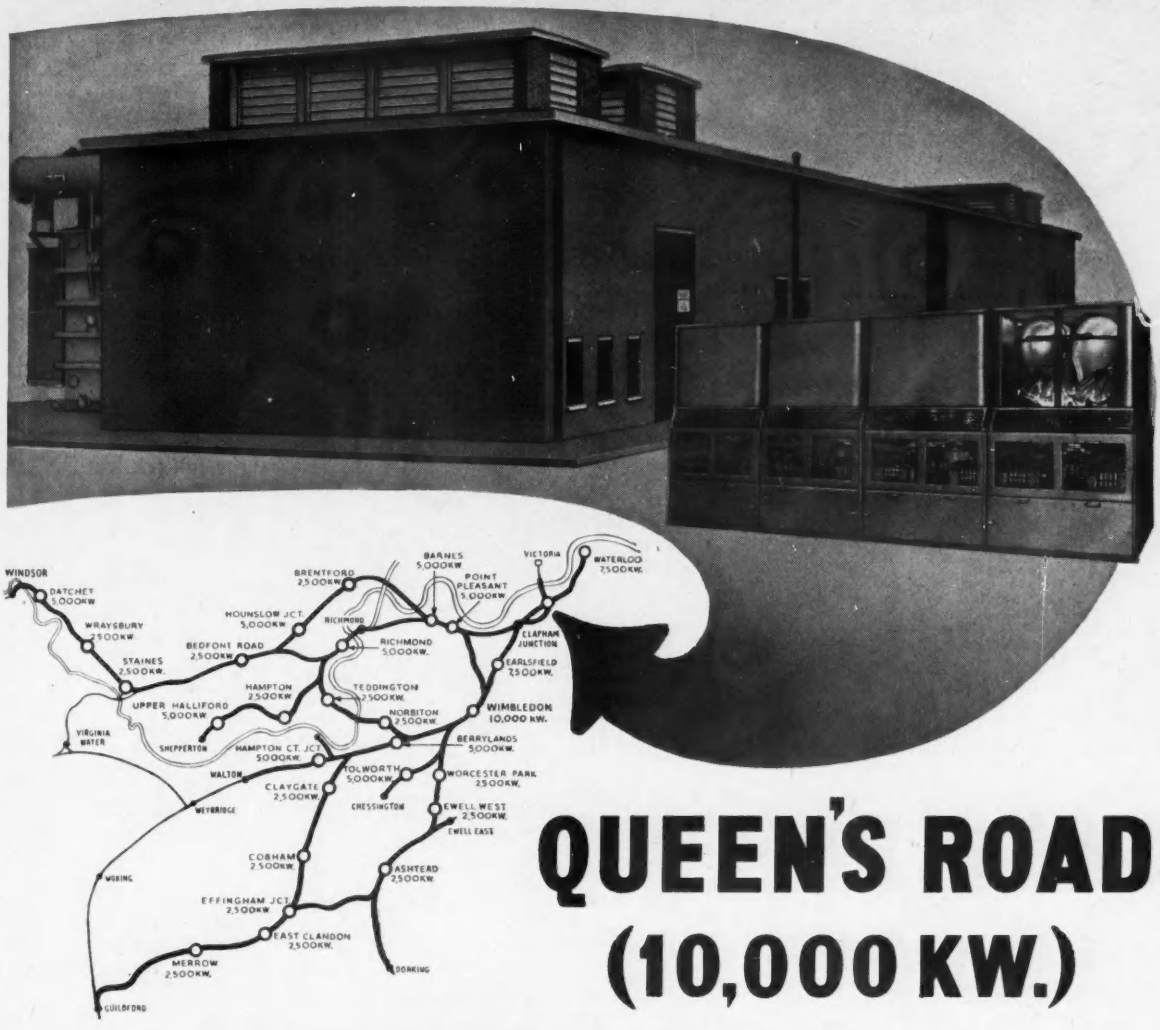
I.E.S. (Bath and Bristol).—"Lighting of Docks and Railway Marshalling Yards." W. T. F. Souter. Elect. Offices, Colston Ave., Bristol, 6.15 p.m.

I.E.S. (Birmingham).—"Lighting for Sport." M. W. Peirce. Regent House, St. Phillip's Place, Colmore Row, 6 p.m.

I.E.S. (Newcastle).—Dinner-dance at Royal Turk's Head Hotel.

I.E.E. (N.E. Students)—"Electrical Safety Precautions." H. W. Swann. King's College, Newcastle, 6.30 p.m.

NOW COMMISSIONED



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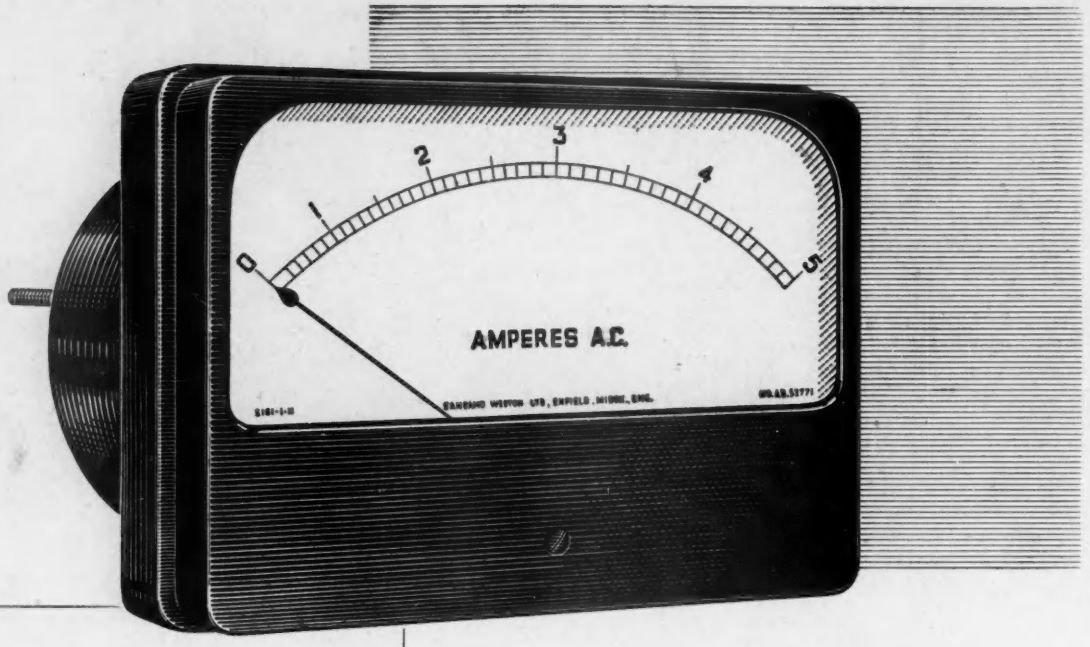
ARGENTINA: H. A. Roberts & Cia., S.R.L. Buenos Aires. AUSTRALIA: Hackbridge and Hewittic Electric Co., Ltd., Sydney. BELGIUM & LUXEMBOURG: M. Dorfman, 124, Avenue des Cerisiers, Woluwé 1, Brussels. BRAZIL: Oscar G. Mors, Caixa Postal 1280, Sao Paulo. CANADA: The Northern Electric Co., Ltd., Montreal, etc. CHILE: Ingenieria Electrica S.A.C., Santiago. EAST AFRICA: Gerald Hoe & Co., Private Bag, Nairobi. EGYPT: Giacomo Cohenca Fils, S.A.E., Cairo. FINLAND: Sähkö- ja Koneliike O.Y. Hermes, P. Esplannaadikatu 37, Helsinki. HOLLAND: J. Kater E.I., Ouderkerk a.d. Amstel, Amsteldijk Noord 103c. INDIA: Steam & Mining Equipment (India), Ltd., Calcutta; Easun Engineering Co., Ltd., Madras, 1. IRAQ: J. P. Bahoshy Bros., Baghdad. MALAYA & SINGAPORE: Harper, Gilfillan and Co., Ltd., Kuala Lumpur. NEW ZEALAND: Richardson, McCabe & Co., Ltd., Wellington, etc. PAKISTAN: James Finlay & Co., Ltd., Karachi. TRINIDAD & TOBAGO: Thomas Peake & Co., Port of Spain. TURKEY: Dr. H. Salim Oker, Karanfil Sokak 59, Ankara. URUGUAY: H. A. Roberts & Cia., S.A.U., Montevideo. U.S.A.: Electro Machinery Corporation, 50, Broad St., New York, 4.

R.P.402/2



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Scottish Factory: Port Glasgow, Renfrewshire. Port Glasgow 41151

Branches: London, CHAncery 4971 · Glasgow, Central 6208 · Manchester, Central 7904 · Newcastle-on-Tyne, Newcastle 26867 · Leeds, Leeds 30867 · Liverpool, Central 0230 · Wolverhampton, Wolverhampton 21912 Nottingham, Nottingham 42403 · Bristol, Bristol 21781 · Southampton, Soton 3328 · Brighton, Brighton 28497

CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

TENDERS INVITED

CITY OF BELFAST
Electricity Department

STREET LIGHTING REMOTE CONTROL
Equipment and Control Switches

TENDERS are invited for the supply and delivery of street lighting remote control equipments and control switches.

Form of Tender and specification (No. W. 27) may be obtained at the Electricity Department, East Bridge Street, Belfast, on payment of a deposit of one guinea, which will be refunded provided a bona fide Tender is lodged and not withdrawn. Extra copies may be obtained at half-a-guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each Tender, in sealed envelope marked "Tender for Street Lighting Remote Control Equipments, Electricity Committee" and endorsed with the name and address of the tenderer, must reach the undersigned not later than 4 p.m. on Friday, 12 Feb., 1954.

An official receipt must be obtained for each Tender delivered by hand. Tenders sent by post should be registered.

The lowest or any Tender will not necessarily be accepted.

JOHN DUNLOP,
Town Clerk.

City Hall, Belfast.
15 Jan., 1954. (G 402)

COUNTY BOROUGH OF GREAT YARMOUTH
Contract for Electric Cables

THE Council invite tenders for the supply of electric cables for a period of one year from 1 April, 1954. Specification, Form of Tender and Conditions of Contract may be obtained from the Borough Engineer, Town Hall, Great Yarmouth.

Tenders upon the form supplied in plain sealed envelopes endorsed "Tenders for Cables" must reach me not later than Thursday, 4 Feb., 1954. No guarantee is given that the lowest or any tender will be accepted.

FARRA CONWAY,
Town Clerk.

Town Hall,
Great Yarmouth.
15 Jan., 1954. (G 415)

CITY OF MANCHESTER

THE HOUSING Committee invite tenders for the Electrical Installation work in the following housing schemes:

Contract 199A for 334 Houses, Greenwood Rd, Wythenshawe.

Contract 193B for 30 Residential Flats, Shadow Moss Rd, Wythenshawe.

Contract 196 for 37 Maisonettes and 31 Flats, Cambridge St and Newcastle St, Hulme.

Specifications, schedules and tender documents may be obtained on payment of a deposit of £1. 1s. (cheques made payable to the Corporation of Manchester and returnable on receipt of a bona fide tender from

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the Director of Housing, Town Hall, Manchester 2. Tenders, which must be sealed in an official envelope endorsed "Electrical Installations" and addressed to the Chairman of the Housing Committee, must be received at the office of the Director of Housing not later than 12 o'clock noon on Monday, 1 Feb., 1954. PHILIP B. DINGLE,
Town Clerk.
(G 364)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

BRITISH ELECTRICITY AUTHORITY
South Western Division

TECHNICAL STAFF VACANCIES

(*a*) ASSISTANT SHIFT CHARGE ENGINEER — Newton Abbot Generating Station, N.J.B. "F" 9, £607-£629.

(*b*) THIRD ASSISTANT ENGINEER (Control)—System Operation Department, Divisional Headquarters, Bristol. N.J.B. "AX/EX" 5, £640-£790/£866-£883.

Superannuation Scheme.

Applicants for (*a*) should have good technical qualifications, and a knowledge of the operation and maintenance of generating plant.

For (*b*) should be Graduates of the I.E.E. or equivalent and have had experience in a steam generating station. Duties will cover load despatching and general shift duties in the Bristol Grid Area Control Room.

Applications on Form A.E.6/ACT, obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by

(*a*) 30 Jan., 1954.
(*b*) 1 Feb., 1954. (G 404)

BRITISH ELECTRICITY AUTHORITY

HEADQUARTERS, London, require a HYDRO INDUSTRIAL AND DISTRICT HEATING ENGINEER in the Generation Design Branch. Candidates should possess an honours degree, have sound practical training and experience and preferably be corporate members of the Inst.C.E., I.Mech.E., or I.E.E. The successful candidate will be in charge of a small group of engineers engaged in the critical examination of hydro-electric power schemes, the investigation and design of thermal-electrical power stations for commercial and industrial steam supplies and district heating schemes, the consideration of heat and electrical load curves and the assessment of necessary installed plant capacities and the preparation of estimates of capital and running costs. Salary N.J.M. Grade 5, £1,800—£1,950 inclusive of London Allowance.

Forms from D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, to be returned by 6 Feb., 1954. Quote Ref. ET/438. (G 370)

ELECTRICITY AUTHORITY OF CYPRUS

REQUIRE a DEPUTY CHIEF ENGINEER for two tours each of two years with prospects of permanency. Salary £1,900 a year plus cost of living allowance at Government rates at present 12½% of salary. Free furnished quarters and passages, leave on full pay at 3½ days per month of residential service. Candidates over 40 must have had previous experience in a position of similar responsibility. Preference will be given to Corporate Members of the Institutions of Electrical and Mechanical Engineers or to those who hold equivalent qualifications.

Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30348/EE. (G 366)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

GENERAL ASSISTANT DISTRICT ENGINEER
REDDITCH DISTRICT, WORCESTER AND DISTRICT SUB-AREA

Applicants should have received a sound training in supply engineering and have experience in overhead and underground H.V. and L.V. systems. Technical qualifications desirable. Salary £447/£460 per annum (N.J.B. Grade E.13). Apply, in writing, within 14 days, stating age, qualifications, present position and salary to Sub-Area Manager, Midlands Electricity Board, Whittington, Worcester.

DISTRICT COMMERCIAL ENGINEER
WELLINGTON DISTRICT, SHROPSHIRE AND HEREFORDSHIRE SUB-AREA

Applicants should have had extensive practical experience in industrial, agricultural and domestic load development in rural and urban areas including preparation of specifications and the completion of tenders for large wiring contracts, supervision of contracting department, public lighting, sales of electrical equipment and service and advice to consumers. Technical qualifications desirable. Salary £803/£834 per annum (N.J.B. Grade E.4). Apply in writing within 14 days stating age, qualifications, present position and salary to Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

A. STEPHENS,
Secretary.
(G 411)

BRITISH ELECTRICITY AUTHORITY

HEADQUARTERS, London, require DEPUTY EDUCATION and TRAINING OFFICER in the Welfare Department. Candidates should be experienced in the initiation and administration of industrial educational policy. They should be capable of preparing schemes of training for all grades of industrial employees, and presenting these for consideration in committee. Duties include arrangement of short courses for employees of the Industry at the Authority's residential training establishments. A knowledge of contemporary human relations training methods, and the national education system is desirable. Salary will be within the scale £1,500 rising by annual increments of £50 to £1,650 inclusive of London Allowance. Pension Scheme. Applications stating age, qualifications, experience and present position and salary to D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, by 31 Jan., 1954. Quote ref. AE/439. (G 342)

BRITISH ELECTRICITY AUTHORITY

MERSEYSIDE and North Wales Division, require SHIFT CHARGE ENGINEER at the Southport Power Station. Salary £633/643 per annum N.J.B. Class D, Grade 7. Superannuable and subject to medical examination. Candidates should preferably have qualifications leading to membership of an appropriate Institution and have a good technical education with experience in the shift operation of a modern power station. Application Forms may be obtained from the Divisional Secretary, Beaconsfield Rd, Woolton, Liverpool, and should be returned not later than 30 Jan., 1954. (G 401)

BRITISH ELECTRICITY AUTHORITY
Southern Division

APPLICATIONS are invited for the following positions:

GENERAL ASSISTANT ENGINEERS AND JUNIOR ENGINEERS
in the Transmission Department
S/13.483 and S/13.484

Applicants should have had a works apprenticeship on switchgear or transformers or have had training and experience of HV and LV supply systems. Experience on either the erection of steel tower overhead lines or laying of HV underground cables will be an advantage, as there are vacancies for the supervision of 275 kV overhead line and 66 kV cable construction work.

Opportunity will be given later for successful candidates to gain experience in either the overhead line, cable or substation sections, or on maintenance work in the Transmission Sections.

Applicants should possess a Higher National Certificate or its equivalent, and for a post as General Assistant possession of qualifications leading to corporate membership of an appropriate professional institution will be considered an advantage.

Salary: General Assistant N.J.B. AX/CX Grade 8, £501—£675. Junior Engineer N.J.B. AX/CX Grade 9, £390—£556.

GENERAL ASSISTANT ENGINEER (ELECTRICAL)
Cowes Site, Construction Department
S/13.485

Applicants should have had experience in the electrical aspects of generating station construction, particularly the laying, jointing and testing of cables, and the erection and testing of switchgear up to and including 33 kV. Candidates should preferably hold qualifications leading to corporate membership of an appropriate professional institution, or possess equivalent qualifications.

Salary: N.J.B. AX/CX Grade 8, £501—£675.

Special application forms, obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, must be returned by 1 Feb., 1954. (G 369)

CHESHIRE COUNTY ARCHITECT'S DEPARTMENT

APPOINTMENT OF ENGINEERING ASSISTANT
Electrical

APPLICATION forms for the above appointment at the minimum of Grades A.P.T. III/IV (£525—£600) may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope and should be returned to him duly completed by 6 Feb., 1954.

Applicants should have had drawing office experience, should hold a H.N.C. in electrical engineering, and be capable, under supervision, of designing electrical layouts for all types of County Buildings.

E. MAINWARING PARKES, F.R.I.B.A.,
County Architect.

The Castle, Chester.
16 Jan., 1954. (G 365)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

APPLICATIONS are invited for the following positions in the Generation Operation Department. N.J.B. service conditions, superannuable appointments, salaries within Schedule "A" of the agreement:

(*a*) ASSISTANT SHIFT CHARGE ENGINEER at Walsall Power Station, Grade G9, commencing at £641 per annum (Vacancy No. 589 MD).

(*b*) STATION SHIFT CONTROL ENGINEER at Nechells "A" Power Station, Grade F10, commencing at £577 per annum (Vacancy No. 590 MD).

Applicants for these positions should have had sound technical training and practical experience, in particular for (*a*) in the operation and maintenance of steam generating plant and for (*b*) in the control and operation of power station plant including main switchgear. Appropriate technical qualifications an advantage.

Apply on form AE6, quoting the vacancy number, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 6 Feb., 1954. (G 403)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

GENERAL ASSISTANT DISTRICT ENGINEER
Gloucester District,
Central Gloucestershire Sub-Area

Experience necessary in all branches of Distribution Work including operation and maintenance of high and low voltage cables and overhead lines, substations, etc. Technical qualifications desirable. Salary £524/£540 per annum (N.J.B. Grade E.11).

DEMONSTRATOR (FEMALE)
Dean Forest District,
Central Gloucestershire Sub-Area

Applicants must have had a good education and should have a certificate of a recognised Domestic Training College and/or the E.A.W. certificate. Duties include lecture demonstrations in Service Centres and on consumers premises and advice to consumers on the selection and use of electrical apparatus. Salary £380/£470 per annum (N.J.C. Grade 1).

Apply, in writing, within 14 days stating age, education, qualifications, training and experience to Sub-Area Manager, Midlands Electricity Board, 126 London Rd, Gloucester.

SECOND ASSISTANT DISTRICT ENGINEER
Worcester District,
Worcester and District Sub-Area

Experience necessary in all branches of distribution work, including construction, operation and maintenance of high and low voltage underground and overhead distribution systems. Technical qualifications desirable. Salary £649/£681 per annum (N.J.B. Grade E.7) (the classification for the year 1953/54 is based on unit sales of approx. 96 millions). Apply, in writing, within 14 days stating age, experience, present salary and position to Sub-Area Manager, Midlands Electricity Board, Whittington, Worcester.

A. STEPHENS,
Secretary.
(G 347)

MIDDLESEX COUNTY COUNCIL
County Architect's Department

JUNIOR ELECTRICAL ENGINEERING ASSISTANT, A.P.T. I (465—£510 p.a. plus London Weighting) Appointment at grade minimum. Established, pensionable, subject to medical assessment and prescribed conditions. Should be able to prepare lighting schemes under supervision and have some knowledge of specification writing and installation work. Application forms (stamped addressed envelope, foolscap) from County Architect, 1 Queen Anne's Gate Bldgs, Dartmouth St, S.W.1, returnable by 2 Feb. (quote M.958 E.T.) Canvassing disqualifies. (G 379)

SOUTH WEST SCOTLAND ELECTRICITY BOARD
Clyde Sub-Area

APPOINTMENT OF SENIOR ASSISTANT ENGINEER
(Operation and maintenance)

APPLICATIONS are invited for the position of SENIOR ASSISTANT ENGINEER (Operation and Maintenance) at Sub-Area Headquarters.

Applicants should preferably be Corporate Members of the Institution of Electrical Engineers or hold equivalent qualifications and have received a sound technical and practical training with long and comprehensive experience in the maintenance of underground and overhead networks and substation equipment up to and including 33 kV.

Salary will be in accordance with the National Joint Board Agreement, Class J, Grade 4, £1,026/£1,071 per annum subject to deductions including Income Tax and Superannuation.

Application Forms, which may be obtained from the undersigned or from any Sub-Area Manager, should be returned to this Office not later than fourteen days from the appearance of this notice.

DANIEL ROSS,
Manager.

206 St. Vincent St,
Glasgow C.2. (G 416)

ELECTRICITY CORPORATION OF NIGERIA

RESIDENT ENGINEER
Oji River Power Station

APPLICATIONS are invited for the post of RESIDENT ENGINEER to supervise on behalf of the Consulting Engineers, the installation and commissioning of all mechanical and electrical works at the Oji River Power Station, Nigeria.

The initial installation comprises 2 x 5,000 kW turbo-alternators, four 33,000 lb/hr boilers with spreader stokers, and the associated coal handling plant, 11 kV and 400 volt switchgear and auxiliary equipment.

Applicants should preferably be Corporate Members of one of the Senior Institutions, and have a sound training in mechanical and electrical engineering and some practical experience with steam power plant.

The appointment is for a two year Agreement on Contract terms totalling £2,040 p.a. The Nigerian £ is at parity with the £ sterling.

Quarters will be provided by the Corporation at favourable rent.

First Class Passages out and home will be provided for the person engaged and his wife. Children's passage allowances may be made in accordance with the Corporation's current regulations.

Leave will be granted upon the satisfactory termination of the Contract at the Corporation's current scale for European officers.

Applications, endorsed "Resident Engineer, Oji River" stating age, qualifications and experience should be forwarded to the undersigned within 14 days of the date of this advertisement.

PREECE, CARDEW AND RIDER,
Consulting Engineers.

8-12 Queen Anne's Gate,
Westminster, S.W.1. (G 392)

LONDON ELECTRICITY BOARD

ENGINEERING DRAUGHTSMAN

APPLICATIONS are invited for the above position in the South Western District.

Applicants should have had a good general and technical education in building construction and architecture, and experience in the design of small buildings in brickwork and reinforced concrete and the drawing up of specifications.

The post is graded under Schedule "D" of the National Joint Board agreement as Grade 6—£458 to £595. 7s. per annum inclusive of London Allowance, and the commencing salary will be dependent upon qualifications and experience.

Application forms obtainable from Secretary, 46 New Broad St, E.C.2, to be returned completed by 30 Jan., 1954. Please enclose addressed envelope and quote ref: V/1701/T on envelope and all correspondence. (G 371)

NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF PURCHASING OFFICER
CHIEF ENGINEER'S DEPARTMENT
Area Board Headquarters

APPLICATIONS are invited, preferably from Corporate Members of the Institution of Electrical Engineers, who have had considerable experience in the Electricity Supply Industry and who are familiar with distribution plant and equipment, for the appointment of Purchasing Officer at Area Board Headquarters, at a salary of £1,750 x £50—£1,900 per annum.

The duties of the post are:

To issue specifications and receive tenders and to advise thereon.

To issue orders for plant and supplies purchased centrally.

To progress work through factories and co-ordinate inspection and delivery.

To negotiate contract price adjustments.

To co-ordinate stock control on certain items throughout the Area.

Applications stating age, qualifications and experience should be received by the Establishment Officer, The North Western Electricity Board, Cheetwood Rd, Manchester 8, not later than Monday, 1 Feb., 1954. (G 391)

BRITISH ELECTRICITY AUTHORITY
Southern Division

APPLICATIONS are invited for the following posts:

SECOND ASSISTANT ENGINEER (MECHANICAL)
CONSTRUCTION DEPARTMENT

Applicants must have had a sound technical and practical training as mechanical engineers and also be well acquainted with the electrical side of Generating Stations. Corporate membership of the Institution of Mechanical and/or Electrical Engineers or suitable equivalent qualifications are essential.

Practical experience in all or some of the following is desirable:

(*a*) Construction experience in Generating Stations which would include design and contract work.

(*b*) Operation of a large modern station.

(*c*) Manufacturing works engaged in the manufacture of the class of plant required for such stations.

Salary N.J.B. AX/CX Grade 2, £834-£1,025.

GENERAL ASSISTANT ENGINEERS (MECHANICAL)
CONSTRUCTION DEPARTMENT
S/13 489

Applicants should have served an apprenticeship in a manufacturing works or have had equivalent practical training. They should preferably hold technical qualifications leading to Corporate Membership of the Institution of Mechanical Engineers or be engaged in an approved course of study leading thereto.

Practical experience either in the operation, design or installation of Modern Generating Station plant is desirable.

Salary N.J.B. AX/CX Grade 8, £501-£675.

Special application forms, obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, must be returned by 3 Feb., 1954. (G 412)

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited for the following positions within the Division

Civil Engineering Draughtsmen
Construction Department
Vacancy No. 1/54

Candidates should have experience in design and detail of reinforced concrete structures, piled and slab foundations for heavy plant, culverts, cable subways, etc., for general building construction drainage and sanitation schemes, associated with official and administrative buildings.

The salary will be in accordance with Grade 5 (£567-£671 per annum) or Grade 6 (£433-£567 per annum) of Schedule D of the National Joint Board Agreement.

Engineering Draughtsmen (Mechanical)
Construction Department
Vacancy No. 2/54

SENIOR DRAUGHTSMEN are required in the Mechanical Section of the Construction Department at North Wilford Power Station. Candidates should have experience in one or more of the following:

(i) Design and layout of Power Station equipment, including turbo - alternators, boiler plant, coal and ash plant, and general station auxiliaries.

(ii) H.P. and L.P. steam and feed pipework. Condensing plant and feed heating systems.

(iii) Conveyor plant, coal handling systems and material handling of station auxiliary equipment.

Salary and conditions of service will be in accordance with the National Joint Board Agreement Grade 5 (£567-£671 per annum) and Grade 6 (£433-£567 per annum) of Schedule D according to experience.

Engineering Draughtsmen (Electrical)
Construction Department
Vacancy No. 3/54

Candidates should have experience in the preparation of layouts and diagrams for the installation of E.H.T. and L.T. Switchgear, transformers, E.H.T. and L.T. cables; knowledge of protective gear systems would be an advantage.

The salary will be in accordance with Grade 5 (£567-£671 per annum) or Grade 6

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(£433-£567 per annum) of Schedule D of the National Joint Board Agreement.

General Assistant Engineer
Transmission (Construction) Department
Vacancy No. 6/54

Applicants must have had considerable experience in the field of all stages of 132 kV overhead line construction and/or civil works in 132 kV Substations. It would be an advantage if applicants possess qualifications leading to Corporate Membership of the Institutions of Civil or Mechanical Engineers.

Salary will be in accordance with Class AX/DX, Grade 8 (£501-£694 per annum) of the National Joint Board Agreement.

The closing date for this appointment is 28 Jan., 1954.

Electrical Maintenance Engineer
Drakelow Generating Station
Vacancy No. 8/54

Applications are invited from suitably qualified engineers.

Applicants should have had a wide experience, in a responsible position, in all aspects of electrical maintenance in a large modern Power Station, and should hold at least the Higher National Certificate (Electrical) and preferably be Corporate Members of the Institution of Electrical Engineers.

Salary will be in accordance with Class J, Grade 6 (£883-£918 per annum) of the National Joint Board Agreement.

The closing date for this appointment is 4 Feb., 1954.

The above positions will be pensionable within the provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form which may be obtained from the Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham, and should be returned to the undersigned by the dates stated. Please quote Vacancy Number.

L. F. JEFFREY, Divisional Controller. (G 418)

BRITISH ELECTRICITY AUTHORITY
North Western Division

FIRST ASSISTANT STATION CHEMIST required at Barton Generating Station, near Manchester. University Degree or A.R.I.C. desirable. Minimum qualification H.N.C. Power plant experience not essential provided applicant has sound experience of chemical analysis. Salary £680/706 (H.9).

Applications stating vacancy No. 6/54, to Establishments Officer, British Electricity House, 825 Wilmslow Rd, Manchester 20, before 13 Feb. (G 387)

BRITISH ELECTRICITY AUTHORITY

TRANSMISSION Design Branch, Headquarters, London, require:

1. POWER CIRCUIT ENGINEER to co-ordinate the work of two small groups of Engineers responsible for the Design, Specification, and Testing of Overhead Lines and Cables. Candidates should have special experience with one of these types of equipment and some knowledge of the practice and principles associated with the other. Good personality and initiative to keep abreast of modern developments is of first importance. Salary N.J.M. Scale 4, £1,650 x £50 to £1,800 inclusive of London Allowance.

2. OVERHEAD LINES ENGINEER to take charge of a small group of Engineers responsible for the Design, Specification and Testing of Overhead Line structures, conductors and fittings. Candidates should have extensive experience in all aspects of overhead line technology and practice, particularly the Design, Construction and Testing of line structures for E.H.V. operation. Salary N.J.M. Scale 3, £1,500 x £50 to £1,650 inclusive of London Allowance.

Candidates should preferably be Corporate Members of the I.E.E.

Forms from D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, to be returned by 6 Feb., 1954. Quote reference ET/434. Candidates who have already applied need not submit a fresh application. (G 393)

SOUTHERN ELECTRICITY BOARD
District Engineer

STAINES District of No. 1 (Southall) Sub-Area. Salary N.J.B. Class F, Grade 3 (£912-£931-£951 per annum, plus London Weighting), N.J.B. Conditions of Service.

Applicants should have had experience in the planning, construction, maintenance and operation of H.V. and L.V. networks.

The successful candidate will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 2-6 Windmill Lane, Southall, Middlesex, and returned to him in envelopes suitably endorsed, not later than 29 Jan., 1954. (G 400)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the undermentioned vacancies:

CHILTERNS SUB-AREA
Luton District
ASSISTANT ENGINEER
(COMMERCIAL)

Candidates must have experience of tariffs associated with Industrial and Commercial consumers and must be able to advise on and estimate for installations in such consumers' premises including power factor correction. A knowledge of street lighting would be a particular advantage. Preference will be given to those holding the Higher National Certificate.

The salary will be in accordance with Class G, Grade 9 of the National Joint Board Salary Agreement, commencing at £641.

Apply to the District Manager—Luton, Eastern Electricity Board, 487 Dunstable Rd, Luton, Beds, within seven days of the appearance of this advertisement.

Northmet Sub-Area, Harrow District 8/54.R.

SENIOR SALES REPRESENTATIVE

The duties will consist of giving advice on supply matters, tariffs, apparatus and sales to consumers with domestic or small commercial or industrial installations in accordance with the National Joint Council Agreement.

The salary will be in accordance with Grade 2 (£640 x £20—£520) of the National Joint Council Salary Agreement, plus London Weighting.

Apply to the District Manager—Harrow, Eastern Electricity Board, Electricity Offices, 4 College Rd, Harrow, Middlesex, within fourteen days of the appearance of this advertisement.

Future salary and conditions of service for the above appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications, by letter, should state age, education, qualifications and experience, with details of present appointment and salary. (G 419)

ASSISTANT ENGINEER
(Distribution)

REQUIRED by the ZANZIBAR GOVERNMENT Public Works Department for one tour of 24/36 months in the first instance. Salary in scale £655, rising to £1,005 a year, outfit allowance £30, free passages, liberal leave on full pay. Candidates under 40 must have served an apprenticeship to Electrical Engineering and have had practical experience of 11 kV and 400/230 volt 3 phase electricity supply system, underground cable and overhead line construction, with small indoor and outdoor substations. They should hold the National Certificate in Electrical Engineering or equivalent and have a practical knowledge of underground cable jointing. Experience of D.C./A.C. change over is desirable.

Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/30336/EE. (G 367)

SOUTH WEST SCOTLAND ELECTRICITY BOARD

SECRETARY
Clyde Sub-Area

APPLICATIONS are invited for the position of SECRETARY of the Clyde Sub-Area with its Headquarters in Glasgow. Applicants must have a Secretarial and/or Legal qualification and have had suitable practical experience.

The salary for the post will be on Scale 2 approved by the National Joint Managerial and Higher Executive Grades Committee, viz.: £1,300 to £1,450 per annum. The appointment is superannuable.

A schedule of duties may be obtained from the undersigned and also an application form, which should be returned to him, duly completed, not later than 8 Feb., 1954.

J. MEEK,
Secretary.

62 Dalziel Drive,
Glasgow S.1.
15 Jan., 1954 (G 385)

SOUTH EASTERN ELECTRICITY BOARD

JOINTER AND JOINTER E.H.T.—Crawley District.

Wages—Jointer E.H.T. 3s. 8d. per hour; Jointer 3s. 6d. per hour for 44 hour 5-day week under N.J.I.C. Agreement.

LINESMAN (Overhead Power)—Crawley District.

Wages 3s. 6d. per hour for 44 hour 5-day week under N.J.I.C. Agreement. Applicants should have experience in construction and maintenance of 11 kV and L.V. overhead lines.

Under certain conditions it may be possible to arrange housing accommodation for persons appointed.

Applications for these vacancies, giving 2 referees, must reach F. A. Avery, A.I.E.E., District Manager S.E.E. Board, 55 High St, Crawley, by 3 Feb., 1954.

A. L. BURNELL,
Secretary.
(G 399)

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, INDIA

APPLICATIONS are invited for the post of ASSISTANT DIRECTOR, Electricity and Magnetism, National Physical Laboratory, New Delhi.

Candidates should be of good academic standing and preferably over 30 years of age. They should have outstanding research experience and experience of guiding research.

Pay within scale Rs. 600—1,500 p.m. (Approximately £540—£1,350 p.a.) Contract for five years, including one year probation. Free sea passage to and from India. Contributory Provident Fund.

Further particulars and forms of application may be obtained on request quoting 4/76E from the High Commission of India, General Department, India House, Aldwych, London, W.C.2. Last date for receipt of application is 1 Mar., 1954. (G 372)

SOUTH WEST SCOTLAND ELECTRICITY BOARD

ASSISTANT CHIEF COMMERCIAL OFFICER

APPLICATIONS are invited for the appointment of ASSISTANT CHIEF COMMERCIAL OFFICER. Applicants should be Corporate Members of the Institution of Electrical Engineers or possess an equivalent qualification in electrical engineering and should have had a wide experience in the utilisation of electricity by all classes of consumers. Practical experience on the administrative side of a Commercial Department essential.

The salary for the post will be on Scale 3 approved by the National Joint Managerial and Higher Executive Grades Committee, viz.: £1,450 to £1,600 per annum. The post is superannuable.

An application form may be obtained from the undersigned and should reach him, duly completed, not later than 8 Feb., 1954.

J. MEEK,
Secretary.

62 Dalziel Drive,
Glasgow S.1.
15 Jan., 1954. (G 386)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SENIOR SERVICE CENTRE ASSISTANT required at the Electricity Service Centre, Mostyn Broadway, Llandudno. Salary within the range of £460/£520 p.a. (Grade 2, N.J.C.).

Applicants should have a sound training in Electrical Retail Trade and a wide knowledge of modern electrical appliances for commercial and domestic use.

The duties of the post will include the supervision and control of the Service Centre, display of apparatus and window dressing, hire purchase transactions and receipt of accounts payable at the Service Centre.

The successful candidate will be given the option of the service tenancy of a self-contained flat above the Service Centre.

The appointment is superannuable and subject to medical examination.

Standard application forms obtainable from the Manager, No. 4/5 Sub-Area, Merseyside and North Wales Electricity Board, Electricity House, Rhostyllen, near Wrexham. Closing date: 1 Feb., 1954. (G 388)

BRITISH ELECTRICITY AUTHORITY
South Eastern Division

ASSISTANT SHIFT CHARGE ENGINEER—Croydon "B" Power Station. Applicants should preferably possess technical qualifications equivalent to Graduate membership of either the Institution of Mechanical or Electrical Engineers. Experience in the efficient operation of modern high pressure power station plant with P.F. firing and experience in the administration and control of labour essential. N.J.B. Conditions of Service and salary Class J, Grade 9 £754, 19s. per annum including London Allowance. Applications giving details of education, present position, experience, etc., should be received by the Station Superintendent, Croydon "B" Power Station, Beddington Farm Lane, Purley Way, Croydon, Surrey, by not later than 30 Jan., 1954. (G 394)

NOTTINGHAMSHIRE COUNTY COUNCIL
County Architect's Department

APPLICATIONS are invited for the following superannuable posts:

ASSISTANT ELECTRICAL ENGINEER
Grade V (*a*) (£625—£685)
JUNIOR ELECTRICAL ENGINEERING ASSISTANT
Grade I (£465—£510)

Applicants for Grade V(*a*) post should be Associate Members of the Institution of Electrical Engineers and be capable draughtsmen with experience in the preparation of schemes, specifications and estimates for all classes of electrical installation work.

Application forms and further particulars are obtainable from the County Architect, County Hall, Trent Bridge, Nottingham, to whom applications should be sent by 29 Jan., 1954. Canvassing disqualifies.

K. TWEEDALE MEABY,
Clerk of the County Council.
(G 368)

NORTH EASTERN ELECTRICITY BOARD
Wear Sub-Area

APPOINTMENT OF SUB-AREA ENGINEER

APPLICATIONS are invited for the position of Sub-Area ENGINEER at Wear Sub-Area Headquarters, Dunning St, Sunderland.

Applicants should have a good general and technical education and practical experience of the design, construction and operation and maintenance of a large distribution system and have experience of control of staff. Applicants should preferably be Corporate Members of the Institution of Electrical Engineers.

Salary will be in accordance with the negotiated scales of the N.J.M. and H.E. Grades Committee—Scale 4, £1,600/£1,750 per annum.

Applications, stating age, qualifications and experience should be marked "Confidential" and forwarded to the Secretary (Establishments), The North Eastern Electricity Board, Carliol House, Newcastle-upon-Tyne, 1, within ten days of the appearance of this advertisement. (G 417)

BRITISH ELECTRICITY AUTHORITY
South Wales Division
Vacancy No. 2/54

APPLICATIONS invited for superannuable N.J.B. appointment of SHIFT CHARGE ENGINEER at Tir John Power Station, Swansea. Salary H.7, £772—£802 p.a.

Applicants should preferably have obtained H.N.C. and served a regular apprenticeship. Previous operation experience in a modern power station essential.

Application forms obtainable from Divisional Secretary, South Wales Division, British Electricity Authority, Twyn-y-fedwen Rd, Gabalfa, Cardiff, should be returned by 30 Jan., 1954.

11 Jan., 1954. (G 378)

BRITISH ELECTRICITY AUTHORITY

HEADQUARTERS require a DISTRICT LABOUR RELATIONS OFFICER, London District. Candidates should have a wide experience in industrial negotiations, a knowledge of the Joint Agreements relating to the Electricity Supply Industry and be thoroughly familiar with Committee procedure. Salary according to qualifications and experience within the scale £1,550 x £50—£1,700 including London Allowance.

Applications stating age, qualifications and experience, present position and salary to D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, by 6 Feb., 1954. Quote reference ET/441. (G 410)

ELECTRICITY CORPORATION OF NIGERIA

IS seeking the following Staff for service in Nigeria. The Corporation is the Supply Authority for the Colony and its staff is liable to transfer from post to post. Furnished accommodation is provided at low rental, free air passages for man and wife, allowances for children, outfit allowance of £60, leave on full pay. Some of the appointments are pensionable whilst others are on short term contract.

ELECTRICAL ENGINEERS

Corporate members I.E.E. wide experience in U.G. and O.H. construction and operation and substation work essential. Experience of installation work and hospital equipment, including X-ray desirable. Salary and expatriation allowance £1,040 to £1,600 p.a.

MECHANICAL ENGINEERS

Corporate members I.Mech.E. Sound practical experience of Babcock Boilers, Reciprocating and Turbine plant, and diesel plant. Knowledge of gas producers useful. Salary and expatriation allowance £1,040 to £1,600 p.a.

MECHANICAL ENGINEERS

For shift work. Membership I.Mar.E. an asset. Naval or Marine experience preferred. Ex. Chief E.R.A. in T.B. or Subs. considered. Salary and expatriation allowance £1,070 to £1,190 p.a.

STOREKEEPER

Good experience in Supply Authorities Electrical and mechanical stores and knowledge of coded systems essential. Overseas experience useful. Salary and expatriation allowance £940 p.a. to commence but this might be increased for a man with the requisite ability.

CONSUMER'S ENGINEER ASSISTANT

Experienced in dealing with consumers' requirements both industrial and domestic and supervision of installation work essential. H.N.C. desirable. Salary and expatriation allowance £940 p.a. but might be increased for a well experienced man.

JOINTERS AND LINESMEN

Experience up to 33 kV and in charge of a gang essential. Single men preferred on contract terms for two tours £1,070 p.a. Higher salary for a man with good teaching experience.

Forms of Application and General Conditions of Service from: Liaison Office in the United Kingdom, Electricity Corporation of Nigeria, 11 Manchester Sq, London, W.1. Closing date for Applications—10 Feb., 1954. (G 425)

BRITISH ELECTRICITY AUTHORITY
South Eastern Division

SENIOR DRAUGHTSMAN (ELECTRICAL) for Brighton "B" Construction Site. Applicants should preferably be educated to Higher National Certificate standard and must have had experience of Power Station design, layout and construction. N.J.B. Conditions of Service. Salary, Schedule D, Grade 5, £567 p.a. rising annually to £671 p.a. Applications giving details of education, present position, experience, etc., should be received by the Resident Site Engineer, Brighton "B" Power Station, Portslade by Sea, Sussex, not later than 30 Jan., 1954. (G 395)

APPLICATIONS are invited for the posts of OVERHEAD LINESMEN to be located in the Drakelow area. Experience of 132 kV steel tower lines essential. Conditions and wages in accordance with N.J.I.C. Schedule. Applications, stating age, experience, etc., should be submitted through Ministry of Labour to Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham. Please quote Vacancy No. 9/54. (G 424)

A PROFESSIONALLY qualified ENGINEER with good experience of electronic servo mechanisms is required for a new factory operating in North Staffordshire. Houses will be available for suitable applicants in the Autumn of this year. Starting salary will be up to £1,000. Write to Box E.T. 890, L.P.E., 110 St. Martin's Lane, London, W.C.2. (G 405)

BRITISH ELECTRICITY AUTHORITY, Merseyside and North Wales Division, require FIRST ASSISTANT CHEMIST at the Connah's Quay Power Station, North Wales. Salary £641/£667 per annum N.J.B. Class G, Grade 9. Superannuable and subject to medical examination. Applicants should have experience in modern power station laboratory work covering the analysis of water, fuel and oil. Possession of a University Degree, A.R.I.C., or equivalent qualification, is desirable. Application Forms may be obtained from the Divisional Secretary, Beaconsfield Rd, Woolton, Liverpool. Closing date: 23 Jan., 1954. (G 380)

THE BRITISH TABULATING MACHINE COMPANY LIMITED (HOLLERITH Punched Cards) has vacancies for executives possessing wide practical experience of accounting (including cost accounting) systems and practices used in public utility organisations. Successful candidates will be given a comprehensive training in the application of HOLLERITH equipment. The commencing salary will be in accordance with qualifications and experience. Applications, which will be treated as being strictly confidential, should be addressed to Sales Personnel Controller, The British Tabulating Machine Company Limited, 17 Park Lane, London, W.1. (G 375)

CAPABLE SENIOR DRAUGHTSMAN required for design of 11 kV metal-clad switchgear equipment. The position offers good prospects. House available to right man. Superannuation scheme. Applications giving full particulars of previous experience, qualifications and salary required to the Personnel Manager, South Wales Switchgear Ltd, Blackwood, Mon. (G 311)

ELECTRIC Motors: There is an opportunity with an established Manufacturing Company for an inside SALES ENGINEER to handle inquiries and orders for industrial motors. The vacancy is based on London. Generous salary offered with participation in non-contributory Pension Scheme.—Box No. 3199, Electrical Times. (G 413)

JOHNSON AND PHILLIPS LIMITED require EXPERIENCED OVERHEAD LINESMEN for E.H.T. and L.T. wood pole Contracts in Eastern Counties and other districts. Applications stating age, experience, copies of references to Employment and Welfare Manager, Messrs. Johnson and Phillips Limited, Victoria Way, Charlton, S.E.7. (G 407)

ELECTRICAL MAINTENANCE CHARGEHAND. A chargehand is required for the Electrical Maintenance Department of this factory. Applications are invited from time served electricians who have had experience of similar work, and in supervision. Preference will be given to those possessing recognised technical qualifications. Staff appointment with contributory Pension Scheme. Applications, giving full personal, educational, service and industrial experience details, and quoting reference E/EMC, to Personnel Manager, Ferodo Limited, Chapel-en-le-Frith, Via Stockport, Cheshire. (G 316)

ELECTRICAL ENGINEER is required for service with The Bahrain Petroleum Co., Ltd. Applicants must have degree or A.M.I.E.E., and have had minimum 5 years' experience of layout and installation covering Power Plant, electrical generators, switchgear, substation, motors and light and power installations in buildings. Age limits 25 to 35 years. Minimum commencing salary £1,140 p.a. Board, lodging and medical attention being provided in addition, other living costs being low. The position is permanent with salaried home leave every twenty-four to thirty months. Kit allowance and pension scheme. Apply with full particulars to Box No. 3195, Electrical Times. (G 398)

FERGUSON RADIO CORPORATION LTD., offers exceptional opportunities to DRAUGHTSMEN wishing to make their career in the world of electronics, television and radio. Candidates preferably experienced in the Radio and Television industries, must have knowledge of mass production methods and workshop practice. Familiarity with Ministry requirements an advantage. Good Salaries; Pension Scheme. Well-equipped Drawing Offices and good working conditions. Apply: Employment Manager, Ferguson Radio Corporation Ltd., Great Cambridge Rd, Enfield, Middx. (G 397)

FOSTER TRANSFORMERS LTD., South Wimbledon, require an ASSISTANT DRAUGHTSMAN with some transformer experience. Annual bonus, in addition to generally recognised pay rates. Good working conditions in modern factory with welfare and canteen services and active sports and social club. Conveniently situated with good tube and bus services. Apply to the Personnel Officer. (G 289)

LABORATORY ENGINEER. Required by a fast expanding firm in Stevenage, Laboratory Engineer, B.SC. or H.N.C. Standard for work on interesting project involving servo control with magnetic amplifiers very desirable. The post is progressive. Housing and Pension Scheme available. Write Box No. 3191, Electrical Times (G 381)

MAJOR oil company requires immediately for employment in Venezuela, South America, ELECTRICAL ENGINEERS, preferably with 5 to 10 years' oilfield experience, for the maintenance/construction high power distribution system, cable/open wiring, transformer stations, power and light installations in buildings, shops, pump installations, houses, etc. In addition candidates should possess an electrical engineering diploma with a minimum of H.N.C. Approximate age 30/38 years, single or married. Salary according to qualifications and past experience. Travelling expenses paid for interviews in London. Please write first instance giving full details age, qualifications, experience and marital status, to Box Z.X.863 Deacon's Advertising (below).

ALSO required, ELECTRICAL ENGINEERS for power plant and construction systems with preferably at least six years' experience operating/maintenance power plant, electrical installations, also transmission systems. Must have electrical engineering diploma with minimum G.I.E.E. Approximate age 25/35 years, single or married. Write giving full details to Box Z.Y.864, Deacon's Advertising, 36 Leadenhall St, London, E.C.3. (G 355)

BOX No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London W.C.2

FOR PAKISTAN

A WELL-KNOWN company in Pakistan, representing several reputable English manufacturers, requires an

ELECTRICAL SALES ENGINEER

normally for employment in Karachi. Age preferred: 22 to 28. Applicant must hold degree in electrical engineering or equivalent from a U.K. university, and have had two years' practical experience with an approved U.K. manufacturer. Preference given to man having training and experience with switchgear manufacture and estimating. Three years' agreement and six months' leave (with pay) from Pakistan if offered second agreement after termination. Initial kit allowance £75. First class passages. Monthly salary for single man, 1,100 rupees first year, 1,200 rupees second year, 1,300 rupees third year, plus local monthly allowance, 150 rupees. (Pakistan rupee at present worth approx. 2s. 2d.) Additional allowance if married. Mutual contributory provident fund. Application must give full details of education, qualification, training and experience, and will be treated confidentially.

Apply Box No. 3187, Electrical Times

(G 373p)

MAINTENANCE ELECTRICIANS required for steelworks plant in Cardiff. Knowledge of automatic control gear for A.C. and D.C. motors essential. Must be member of E.T.U. and prepared to work shifts on 48-hour week.—Box No. 3205, Electrical Times. (G 422)

MAINTENANCE ENGINEER (MECHANICAL) with good technical qualifications required for 80 MW industrial Power Station. Age not less than thirty or over fifty. Commencing Salary £800 to £900. Non-contributory Pension Scheme. Up-to-date Power Station experience essential. Apply in writing to Salaried Personnel Department, Ford Motor Company Limited, Dagenham, Essex. (G 327)

PERSONAL ASSISTANT to Head of Technical Department in London factory. Electrical Engineering or Physics Graduate preferred with service or other admin. experience. Age 35/45. Duties include radio refresher lectures to Senior Engineers and Supervisors, preparation of reports and technical papers and admin. control of students and post-graduates. High grade personal qualities a strong recommendation. Apply with full details of qualifications and salary required to Department 6, 63 Aldwych, W.C.2. (G 420)

REQUIRED for established wholesale electrical distributors, keen SALESMAN for outside representation, Cambridge area. Basic salary and generous commission. Numerous existing contacts available. Write stating age and previous experience.—Box No. 3189, Electrical Times. (G 374)

SENIOR SALES ENGINEER, with specialised knowledge of electrical rotating machinery 1-100 h.p. and control gear, to be responsible for small group of Sales Engineers. Appointment based on London. Generous salary and expenses. Non-contributory Pension Scheme.—Box No. 3201, Electrical Times. (G 414)

SHIFT POWER STATION ATTENDANT required for heavy industrial plant in Cardiff. Applicants should have maintenance experience on large electrical machines and preferably a knowledge of H.T. distribution systems. 48-hour week. Full E.T.U. membership essential.—Box No. 3203, Electrical Times (G 421)

TRANSFORMER DRAUGHTSMAN, age 30/40 years, required to take charge of Drawing Office. Experience in Transformers to 4,000 kVA 33 kV essential. Must be able to control staff and a good organiser. Pension scheme available. Apply giving details education, experience, salary, to: Lindley Thompson Transformer Co., St. Mary's Rd, Slough. (G 376)

CHIEF DESIGNER—Applications are invited for the position of Chief Designer Industrial Electric Cooking and Heating Equipment.

Applicants who should be between the ages of 30-45 and with previous design experience in this field should submit all details in writing of experience, qualifications and salary required, to: The Secretary, Simplex Electric Co., Ltd., Blythe Bridge, nr. Stoke-on-Trent, Staffs. (G 426)

TRAVELLING REPRESENTATIVE required to service and install simple electrical apparatus throughout country. Must be practising Christian, single, with basic electrical knowledge. Write with full particulars to "P," c/o J. E. May Ltd., Advt. Agents, 19 Ludgate Hill, London, E.C.4. (G 396)

APPOINTMENTS WANTED

LIGHTING ENGINEER (25). Six years' thorough experience, covering Commercial, Industrial and Floodlighting fields, desires a position where prospects exist. An interview is sought with a firm who requires the services of a first-class man, with initiative, enthusiasm, a good personality and the ability to get on with people. Write Box No. 3193, Electrical Times. (G 382)

WORK WANTED

A.C. and D.C. MOTOR REWINDS and REPAIRS. Prompt service fully guaranteed. Edgware 5566 (4 lines).—Service Electric Co., Ltd., Stanmore, Middx. (G 13)

ARMATURE REWINDING service to the trade. Vacuums, Drills, Grinders, Hood Dryers, Dental Motors. Vacuum cleaner and drill armatures replaced from stock 24-hour service. Every job guaranteed. All vacuum cleaner parts, hoses, etc., in stock for any make. Apex washer agitator shafts stocked.—Regam Electric Cleaner Service, 95, Park Lane, Leeds, 1. (G 20)

WORK WANTED. Capacity available for all types of COIL WINDING.—Box No. 2425, Electrical Times. (G 17)

ALL types Motors, Drills, Vacuum Cleaners, etc., efficiently REPAIRED or REWOUND at competitive prices. Repetition work a speciality. Quotations invited. Kingsmill Electrical, Locking Rd, Weston-super-Mare. (Telephone: W-s-M 2473.) (G 303)

METALWORK. All types cabinets, chassis, racks, etc., to your own specification.—Philpott's Metalworks Ltd., Chapman St, Loughborough. (G 38)

WANTED

GOOD modern transformer type WELDING EQUIPMENT, 400/3/50. Box No. 3185, Electrical Times. (G 337)

WANTED, D.C. and A.C. ball-bearing MOTORS, MOTOR GENERATOR SETS, DYNAMOS and ALTERNATORS.—Full details to Britannia Manufacturing Co., Ltd., 22-26, Britannia Walk, London, N.1. (G 4)

WANTED, for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. and H. Cooper Ltd., 176 Brady St, Bethnal Green, E.1. (G 1)

WANTED. Large quantity of 4-in. outside diameter TUBES from the dismantling of old Babcock water-tube boilers. Best prices paid. Prepared to purchase Babcock and Wilcox water-tube boilers for dismantling.—Apply, giving full details, to Midland Iron and Hardware Co., Cradley Heath, Staffs. (G 2)

WANTED. ROTARY CONVERTERS, any size.—Universal, 221 City Rd, London, E.C.1. (G 6)

FOR SALE

NO. 2 TRANSFORMERS, 50 kVA 400/230 V. Davenset (1949). In excellent condition. Apply, The Cementation Co., Ltd., Ellerbeck Site, Slaidburn, Nr. Clitheroe. Tel.: Slaidburn 228. (G 409)

INDUSTRIAL ELECTRIC MOTORS, ½ h.p. English Electric Single-Phase Split-Phase, 230/250 V, 50 cycles, 1,440 r.p.m. Also large range of well-known makes from 1-6 h.p., varied voltages, majority 1,440 r.p.m. All brand new at reduced prices. For comprehensive lists apply to Tecalemit Ltd., Great West Rd, Brentford, Middlesex. Ref. QFO/OJB. (G 423)

NO. 7 PRIOR STOKER, fully automatic. Good condition.

Higgs motor, single phase, 460 V with starter, condenser and pulley, Mains Transformer, new, 1 kVA. Primary Volts 230 secondary Volts 50. Secretary, Hospital, Scorton, Yorks. (G 408)

SALES BY TENDER

THE Merseyside and North Wales Electricity Board offer for sale as scrap 18 Distribution TRANSFORMERS of various sizes and voltages.

These transformers may be inspected at the Board's depot at Legacy, near Wrexham, from 25 Jan. to 5 Feb., 1954, inclusive.

Forms of Tender, available from the Manager, No. 4 Sub Area, Merseyside and North Wales Electricity Board, Electricity House, Rhostyllen, Wrexham, must be forwarded through the post under cover of the label provided so as to be received at Electricity House, Rhostyllen, Wrexham, not later than noon on Wednesday, 10 Feb., 1954.

The transformers are offered for sale individually or as a whole, and the Board do not bind themselves to accept the highest or any tender and reserve the right to accept the whole or any part of any tender.

M. M. PARKER,
Secretary.
(G 389)

SALES BY TENDER

THE Merseyside and North Wales Electricity Board offer for sale approximately 6 Tons of Scrap Insulated Overhead and House-wiring CABLE, of which approximately 4 Tons may be inspected at the Board's Central Stores, H.M. Factory Site, Queensferry, near Chester, and the remainder at the Board's Central Stores, St. Helen's Rd, Caernarvon, from 25 Jan. to 5 Feb., 1954, inclusive.

Forms of Tender obtainable from the Manager, No. 4 Sub Area, Merseyside and North Wales Electricity Board, Electricity House, Rhostyllen, Wrexham, must be forwarded through the post under cover of the label provided so as to be received at Electricity House, Rhostyllen, Wrexham, not later than noon on Wednesday, 10 Feb., 1954.

The Board do not bind themselves to accept the highest or any tender and reserve the right to accept the whole or any part of any tender.

M. M. PARKER,
Secretary.
(G 390)

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, SWITCHGEAR, EXHAUST FANS, HOISTS, REDUCTION GEARS, new or reconditioned units.—Chi 5105, 67 Rothschild Rd, W.4. (G 7)

A.C. and D.C. MOTORS, all sizes, large stocks. Fully guaranteed.—Milo Engineering Works Ltd., Milo Rd, East Dulwich, S.E.22 (Forest Hill 2278-9). (G 3)

A.C. and D.C. MOTORS, GENERATORS from stock.—Service Electric Co., Ltd., Honeypot Lane, Stanmore, Middx. Edgware 5566-9. (G 9)

A HIGH VACUUM IMPREGNATION UNIT or single or batch coil impregnation service to R.I.C. Specification 214 or individual requirements. — Blickvac, 505 Lordship Lane, S.E.22. Tel.: Forest Hill 7089. (G 18)

ALTERNATORS, 665 kVA, 500 kW, revolving field ALTERNATOR by Siemens. Type 819 UR, for 5,000/3/50. Open type with bell shields, underslung yoke, direct coupled Exciter 250 volts. Speed 333 r.p.m.

625 kVA, revolving field ALTERNATOR by E.E.C. for 440/3/50, 4 wire supply, with direct coupled Exciter 17·5 kW 50 volts. Speed 600 r.p.m.

600 kVA, 480 kW, revolving field ALTERNATOR by E.E.C. for 400/3/50, with direct coupled Exciter Generator. Speed 600 r.p.m.

385 kVA, 308 kW, revolving field ALTERNATOR by L.D.M. for 400/3/50, 0·8 p.f., open type with direct coupled Exciter. Speed 600 r.p.m.

350 kVA, revolving field ALTERNATOR by Mather and Platt, for 400/3/50, 0·8 p.f. Open type with direct coupled Exciter. Speed 750 r.p.m.

George Cohen, Sons and Co., Ltd., Wood Lane, London, W.12. Tel.: Shepherds Bush 2070 and Stanningley, nr. Leeds. Tel.: Pudsey 2241. (G 304)

A.C.-D.C. QUARTERLY and SLOT METERS.—Brent Electrical Co., 6 Holmdale Gardens, London N.W.4. (G 5)

DON'T worry about your electricity bills. Fit 1s. slot electric meters for hotels, bed-sitters, etc. Prices from 50s.—Selectrics, Department E.T., Castle Circus House, Torquay. Tel. 7218. Trade inquiries invited. Trade discount. (G 21)

HOUSE-SERVICE METERS, a.c. or d.c., quarterly or prepayment.—Universal Electrical, 221 City Rd, London, E.C.1. (G 10)

MERCURY SWITCHES are made by Hall, Drysdale and Co., Ltd., of 58 Commerce Rd, Wood Green, London, N.22. Tel.: BOW. 7221. (G 11)

FLAMEPROOF MOTORS, M.G. SETS, D.C. MOTORS, GEARED MOTORS, A.C. MOTORS, TRANSFORMERS, CONTROL GEAR. SPECIALS. FLANGE MOTORS.

ELECTROPOWER COMPANY LIMITED

Kingsbury Works, Kingsbury Rd, London, N.W.9

Tel.: COLindale 4621/3,

Grams: Lektropowa, Hyde, London (G12p)

BOURNE
South Lincs.

DISPERSAL SALE by Auction without reserve of the whole of the new ELECTRICAL CONTRACTORS STOCK IN TRADE and Effects for C. Palmer, Esq, who is retiring from business, amounting to about 550 lots and including Brook Motors, Blacksmith Forge Blowers, Star Delta Starters, Contactor, Various Switches, Plugs, Sockets, etc., Tubing, Flexes and Coils, Clocks, Cooker, Copper, Water Heater, Lamps, etc., which

H. H. MORRIS, F.A.I.

having sold the Premises will sell at The Corn Exchange, Bourne, for convenience of Sale on Thursday, 4 Feb., 1954, Sale at 10.30 a.m. View Day 3 Feb., 10.30 a.m. to 5 p.m.

Catalogues from the Auctioneers, 15 Southgate, Sleaford, Lincs. (Tel. 271/2.) (G 384)

ELECTRIC MOTORS for sale in first-class condition: Four only English Electric 4 h.p., 400-440 V, 3 ph., 50 c/s, revs. 955, protected type s.c. induction.

One only Laurence Scott and Electromotors Ltd., s.c. induction motor 4 h.p., 400-440 V, 3 ph., 700 r.p.m.

One only Laurence Scott and Electromotors Ltd., s.c. induction motor, 6 h.p., 400-440 V, 3 ph., revs. 2,900.

One only English Electric s.c. induction motor, 6 h.p., 400-440 V, 3 ph., revs. 950.

One only English Electric s.c. induction motor, 11 h.p., 400-440 V, 3 ph., revs. 720.

One only Crompton Parkinson slip-ring motor, with short circuiting gear, 12·5 h.p., 400-440 V, 3 ph., revs. 930.

Apply by letter only. Lyle and Scott Ltd., Lothian St, Hawick, Scotland. (G 358)

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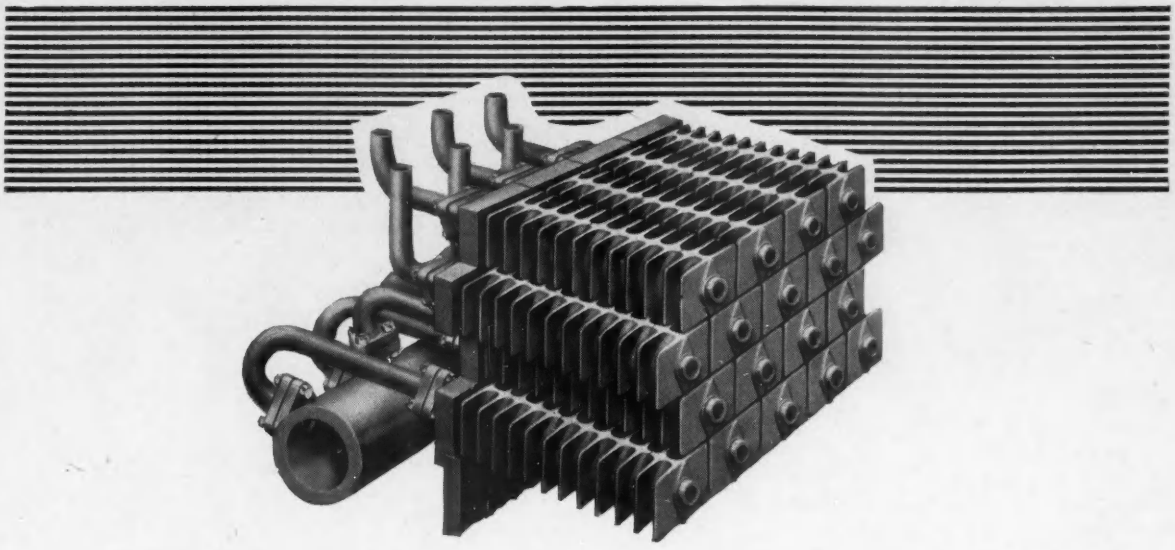

Greens of Wakefield specialise in the design and manufacture of Economisers, of which they were the original inventors, and have the longest experience. Greens make Economisers of all types, for all pressures. The section illustrated is the Premier Diamond Steel Tube Economiser for highest pressures, with cast-iron gilled sleeves shrunk on steel tubes arranged in shallow tiers. This design combines the advantages of extended heating surface in compact dimensions, controlled gas flow and the most complete facility for inspection and cleaning. Also available with welded joints.

You should specify a Green's Economiser—

and that's why!

GREEN'S ECONOMISER

E. GREEN & SON LTD · WAKEFIELD

Makers of economisers for more than one hundred years

GE130

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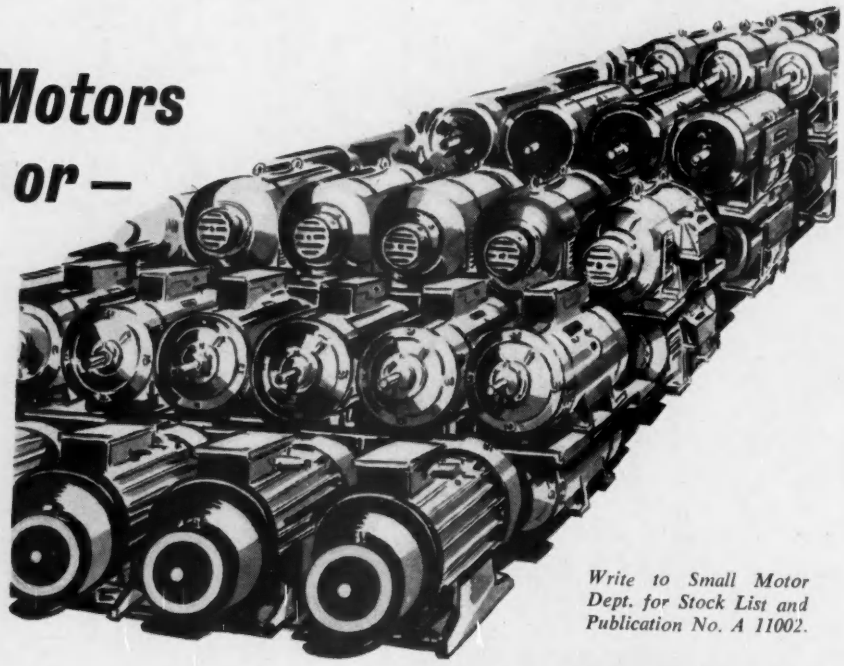

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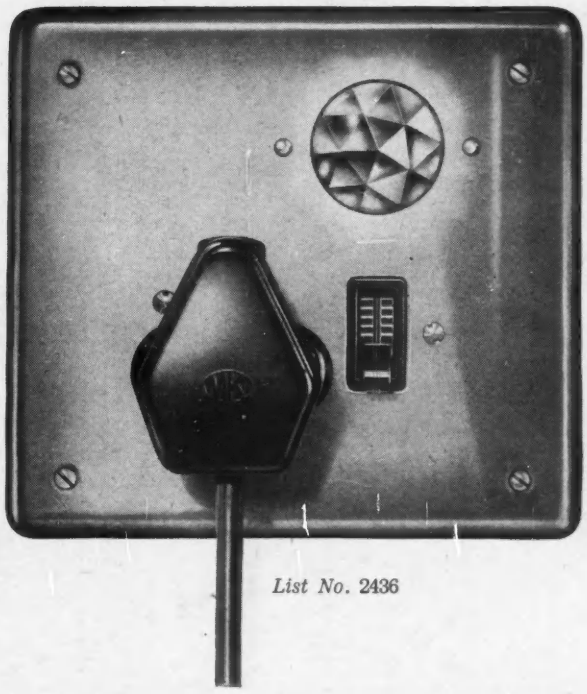

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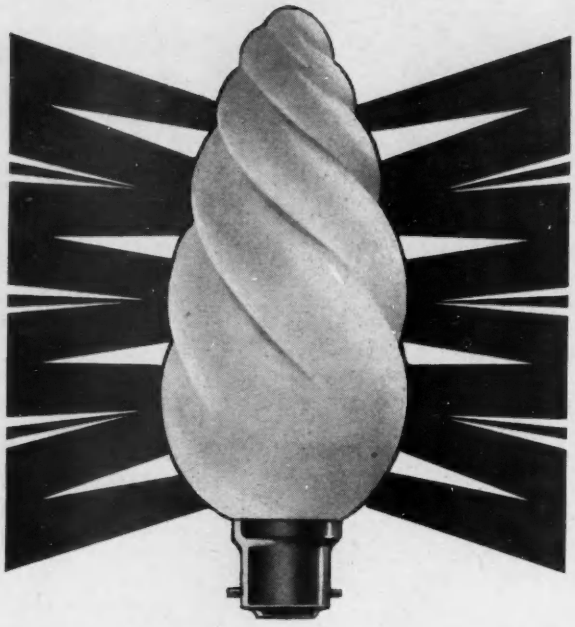

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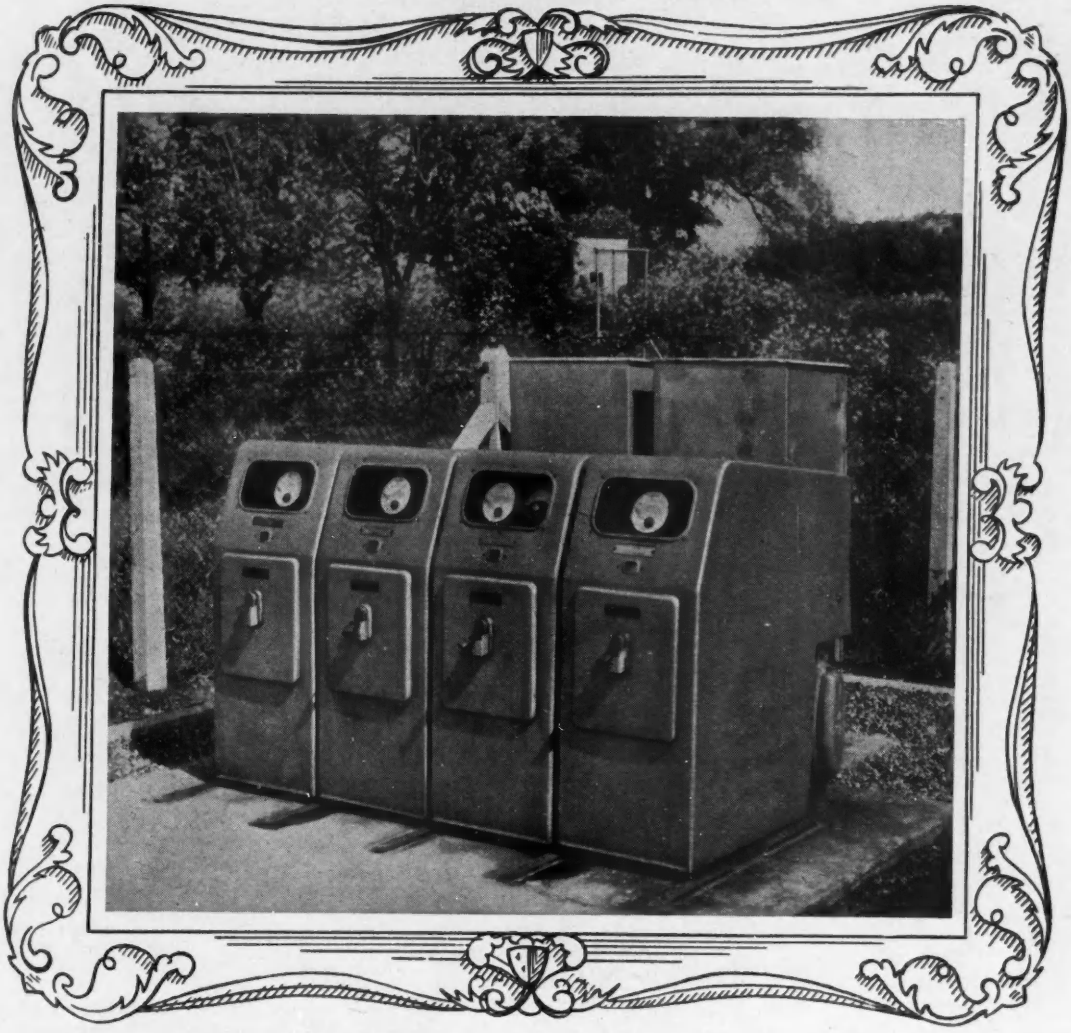

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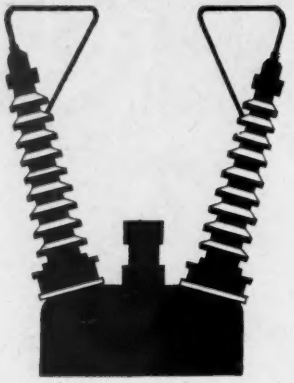

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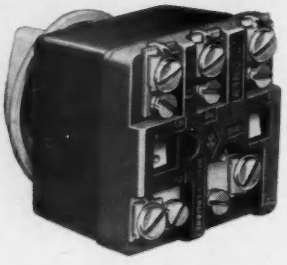

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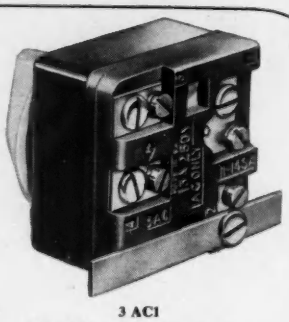

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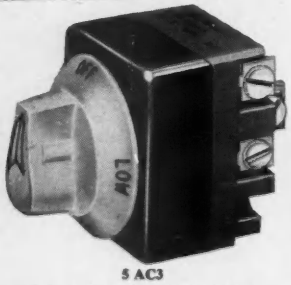

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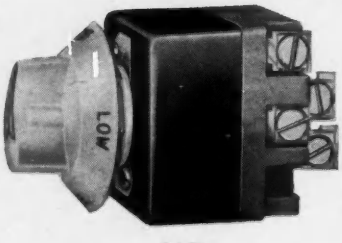

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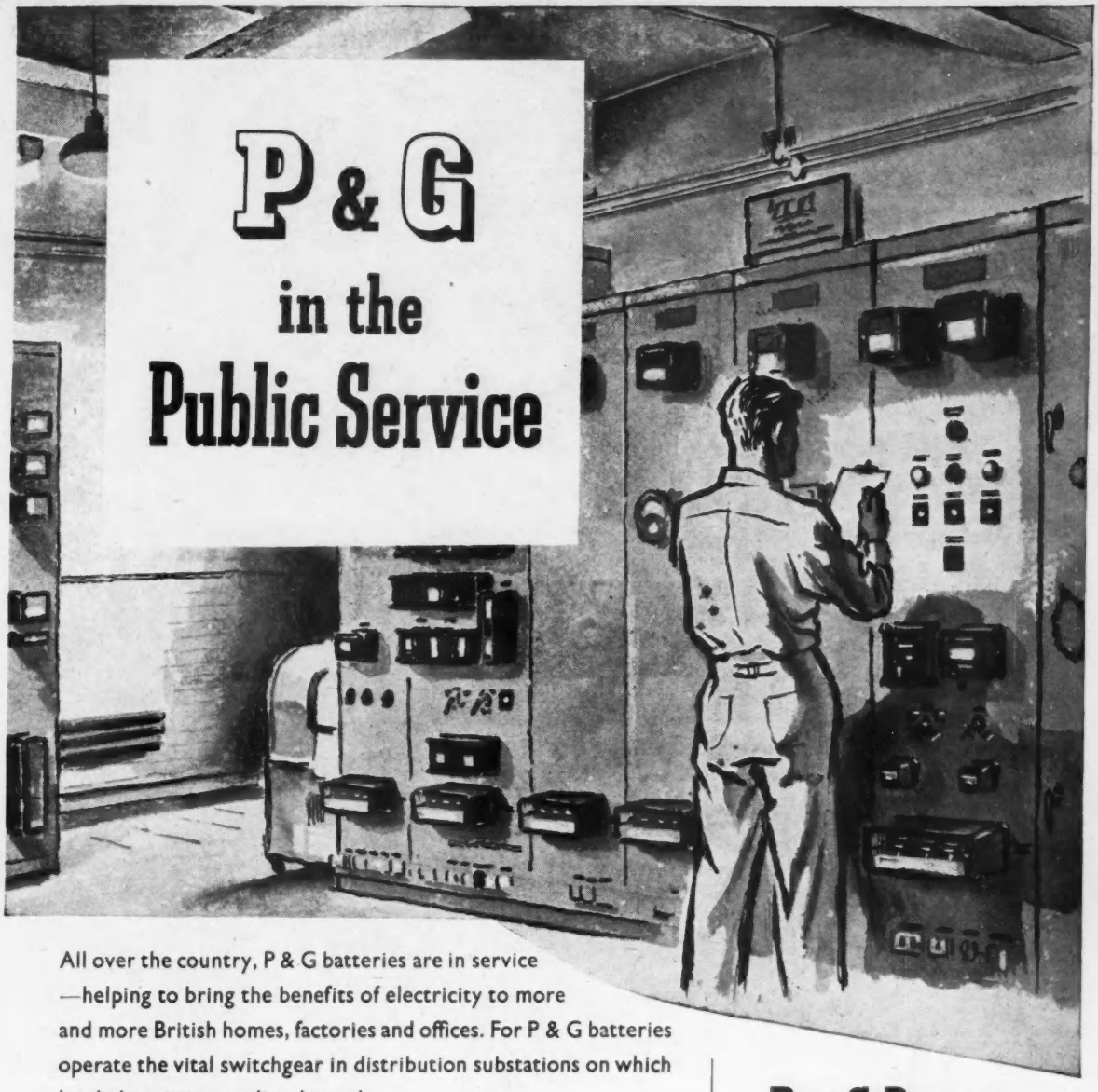

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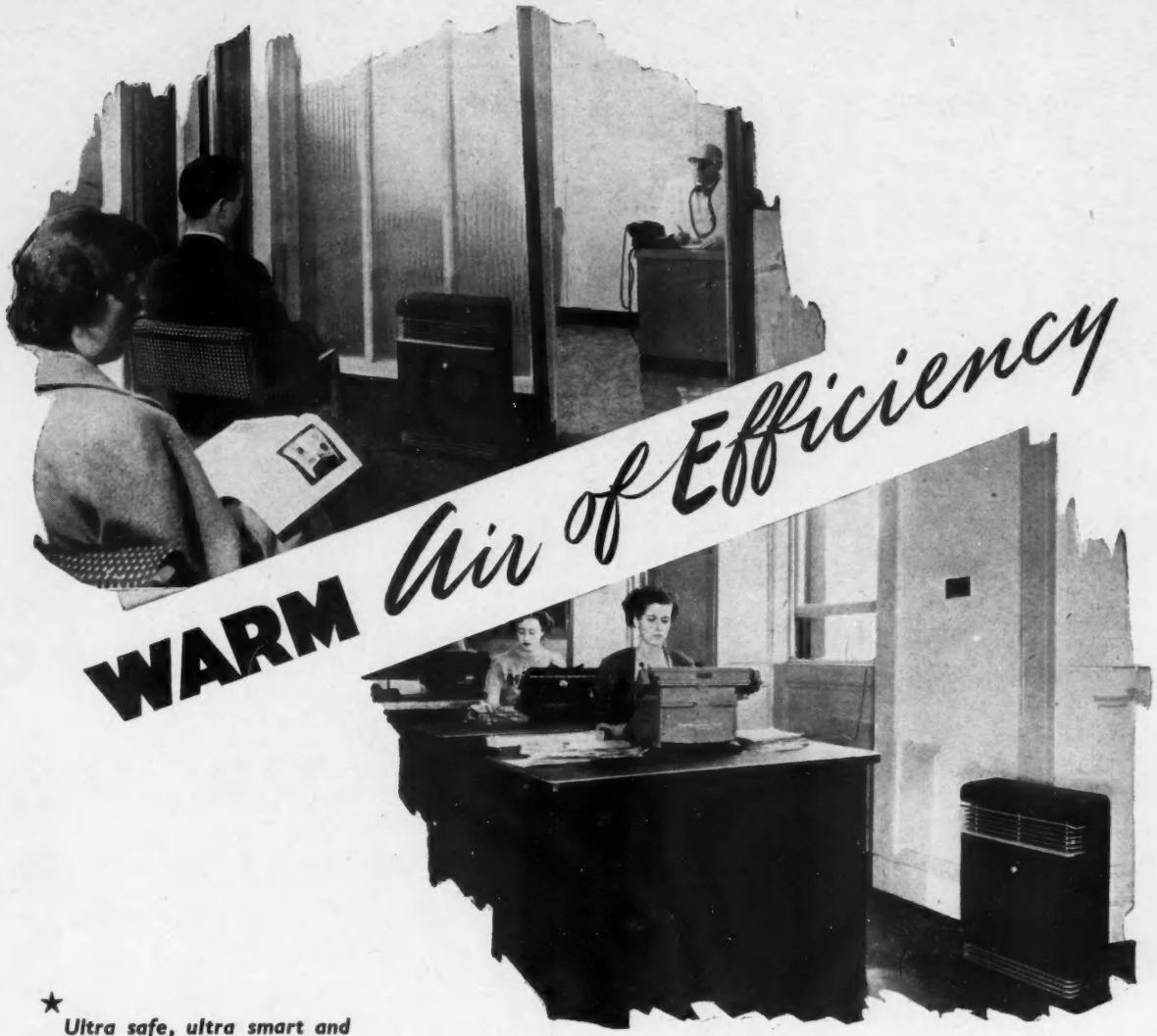

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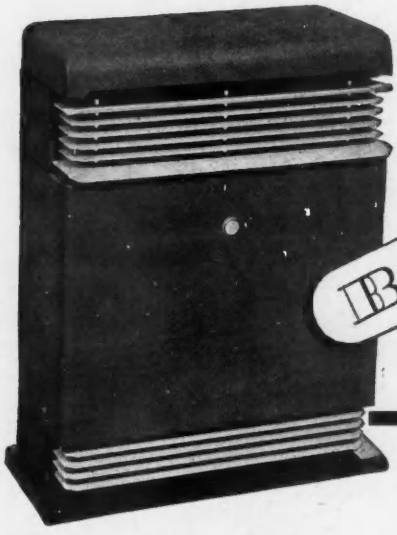

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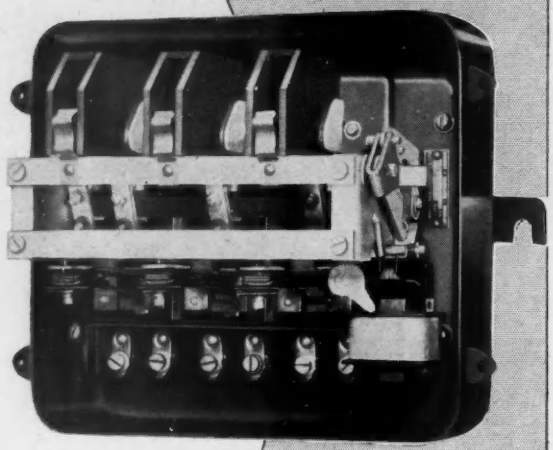

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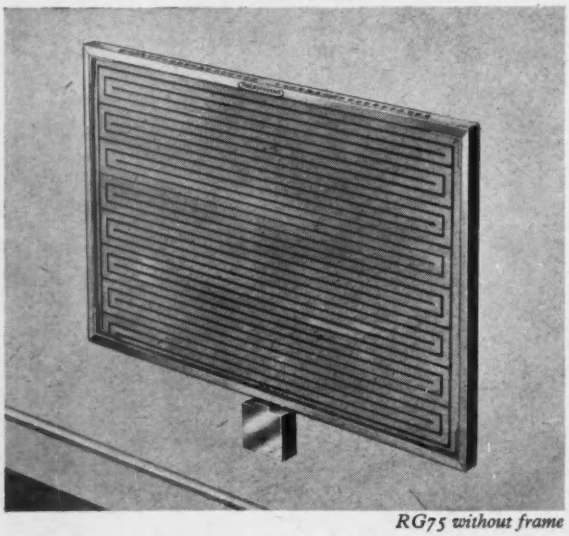

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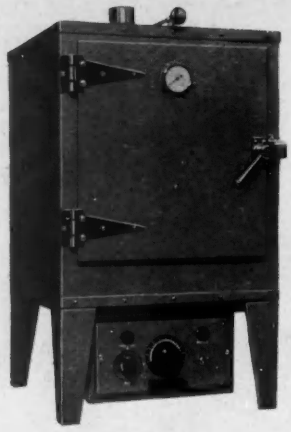

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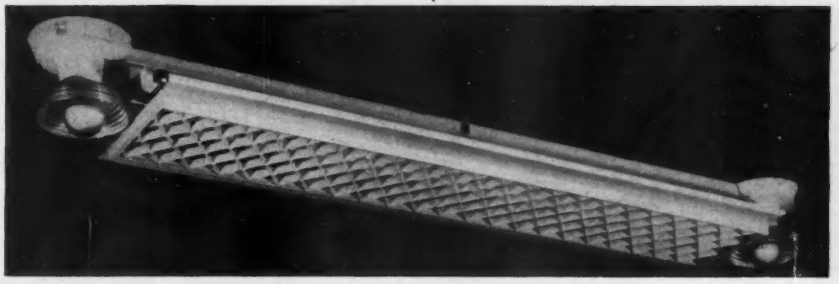

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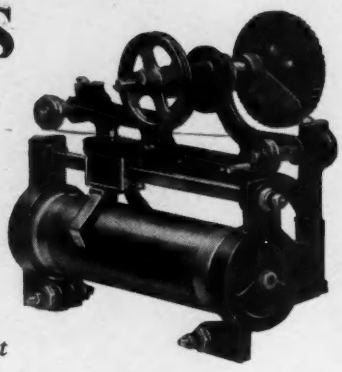

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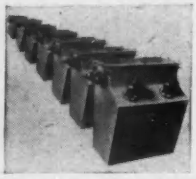

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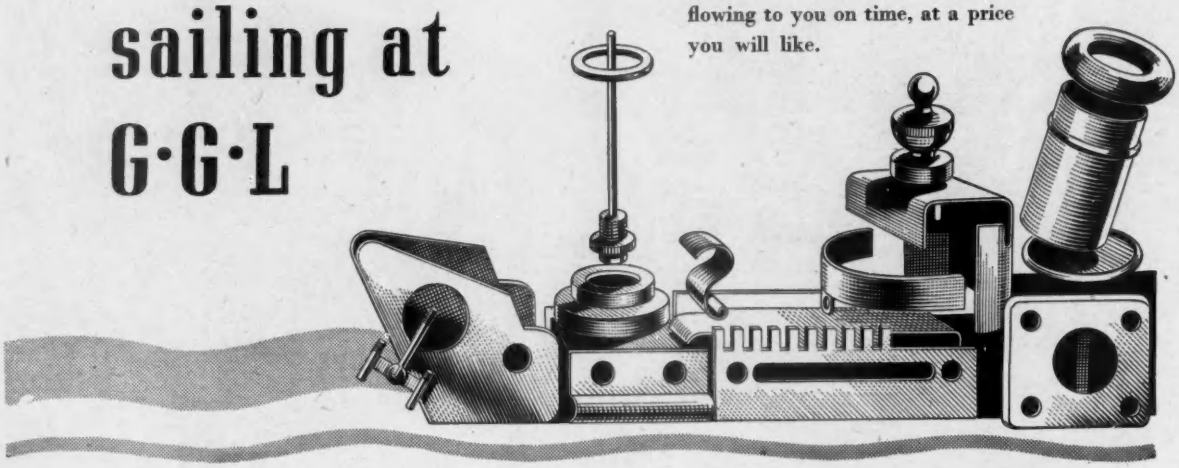

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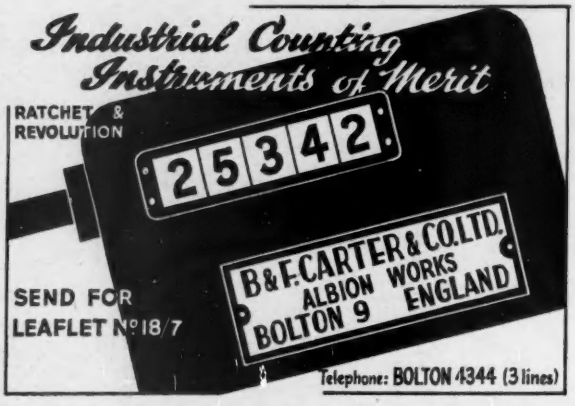

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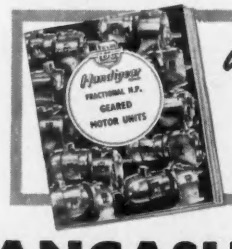

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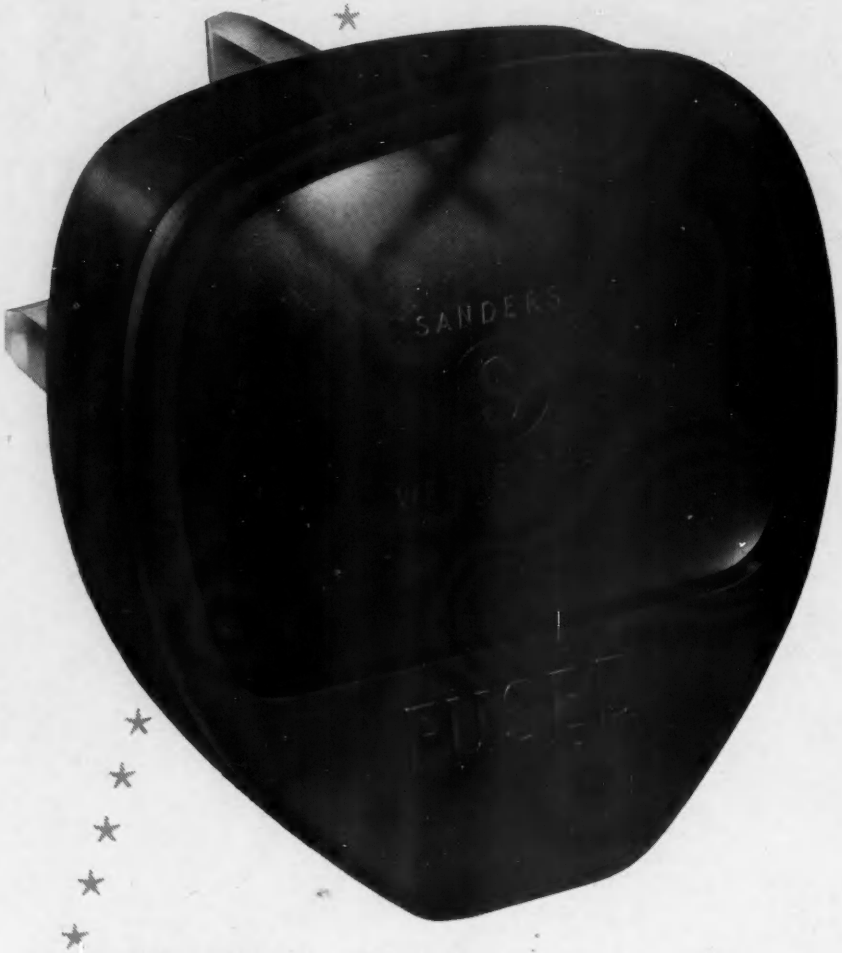

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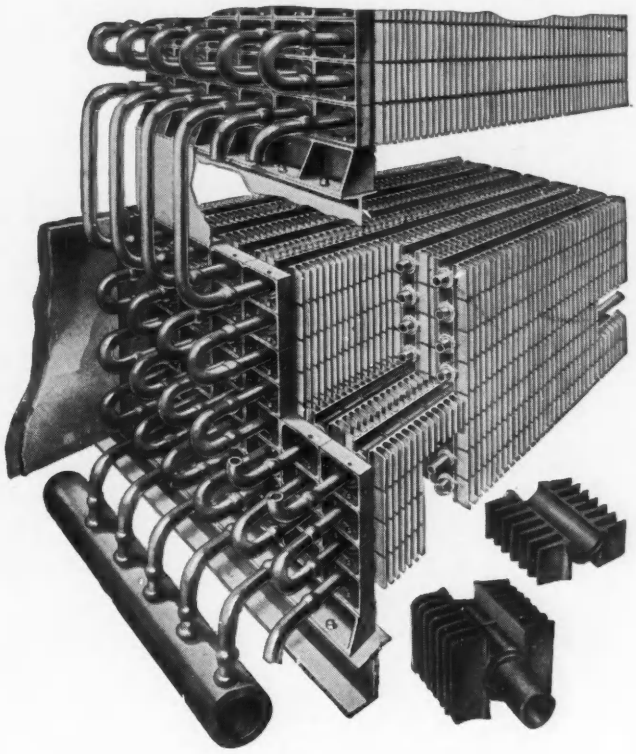

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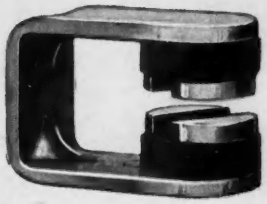

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